A WINDOW OPEN ON THE WORLD

The UNESCO Courier

FEBRUARY 1964 (17TH YEAR) PRICE : 50 CENTS

LASERS

100 million messages on a beam of light

ERSI
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ODICAL
NG ROOM

CHILDREN IN THE PALM TREE

This painting, which might have come from a book of children's stories, is a detail of "Entry into Jerusalem" a 13th-century Byzantine fresco in one of the monastery churches of Cyprus. Wearing black gloves, the children are climbing the palm tree to gather dates. The painting is reproduced in full colour in a new Unesco World Art Series album, "Cyprus: Byzantine Mosaics and Frescoes" (See p. 30).

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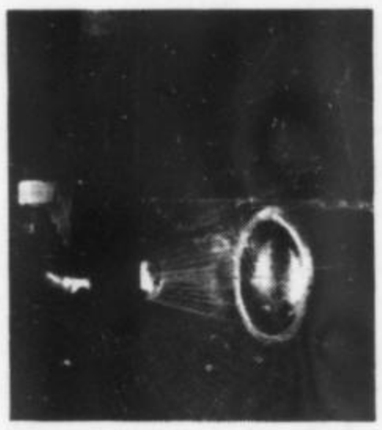

COVER PHOTO

To drill a hole through a steel plate with a single flash of light, as this laser is doing, is already an impressive feat. But the special qualities of laser light open the way to far more striking possibilities in communications, radar, surgery and many other fields. (See p. 15).

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A special Unesco report

TODAY'S TRENDS IN WORLD COMMUNICATIONS

© Paul Almasy, Paris

EVERY day, some 300 million copies of daily newspapers, 400 million radio receivers and 130 million television sets bring news and information to the people of the world. Over 212,000 fixed cinemas and many thousands of mobile units provide them with entertainment and information.

These facts emerge from a 380-page report, *World Communications* (1), just published by UNESCO, which gives the latest information on press, radio, film and television facilities throughout the globe. It also highlights trends in these media during the past decade.

Significantly, all the mass media, except the daily press, expanded more rapidly during this period than world population, which increased by 26 per cent. The world's total of radio receivers advanced by 60 per cent; the number of fixed cinemas doubled and the total of TV sets tripled. Daily newspaper circulation rose by no more than 20 per cent.

Many gains in press, radio and film were scored in the developing countries. Television, almost unknown in 1953 in Africa, Asia and Latin America, has spread swiftly to all parts of the world. Nevertheless, the cinema has maintained a leading role in the world of entertainment, its weekly total of spectators equalling one-eighth of the world's population.

There has been a world-wide growth in the news agency field. As many as 155 agencies are now operating in 80 countries, compared to 96 agencies in 54 countries a decade ago.

Another striking trend has been the growing use of the mass media for education in both developed and developing countries (see article page 12).

World Communications emphasizes, however, that the information media are very unequally shared between nations and points out that some 70 per cent of the

(1) Published in Paris 1964; price 47/stg., $9.50, 33 F. (cloth bound); also published in the U.S.A. as a co-edition with the Unesco Publications Center, New York.

Unesco's latest global report on press, radio, films and TV shows that though information media are outpacing population growth, they are still very unequally shared, 70% of the world lacking adequate facilities. Europeans, for example, buy 38% of world daily papers and North Americans 23%, while Africans, Asians and South Americans together only buy 26%. Above, study in intent readership offered by youngsters around a street-corner magazine vendor's pitch in Lima, Peru.

world's peoples, living in over 100 countries of Africa, Asia and Latin America, still lack adequate communication facilities: in terms of daily newspapers there should be at least 10 copies for every 100 people.

Europeans buy 38 per cent of world daily papers, and North Americans 23 per cent, while Africans, Asians and South Americans together buy only 26 per cent. In the United Kingdom there are 51 copies of daily papers for every 100 people—the world's highest level—compared to only one paper for every hundred Africans or Indians.

In most countries throughout the world, daily newspapers have increased in circulation since 1950. Some of the larger countries have registered significant advances. The general interest daily press of the United States, with a total of 59 million copies, claims a rise of four million since 1954. In the same period, daily circulation has expanded by five million copies in Japan and nine million in the U.S.S.R. to reach a level of 39 million in each country.

It seems clear that newspaper publishing now stands on the verge of the most important technical revolution in its 400-year history.

In the field of printing itself, electronics and automation have solved many problems in production control, especially on high-speed rotary presses, as well as in actual production. This is a feat which few believed possible as little as 15 years ago.

There has been a vast improvement in rotary offset printing, due largely to the use of photocomposition, better inking, faster etching methods, the electronic engraving of plates and electronic control of registers. Indeed, the days of conventional printing in raised type, used since the time of Gutenberg and Caxton, appear to be numbered. Its place will probably be taken by various forms of photocomposition or filmsetting, that is, of printing plates prepared from photograph negatives, including both text and illustrations in the same process,

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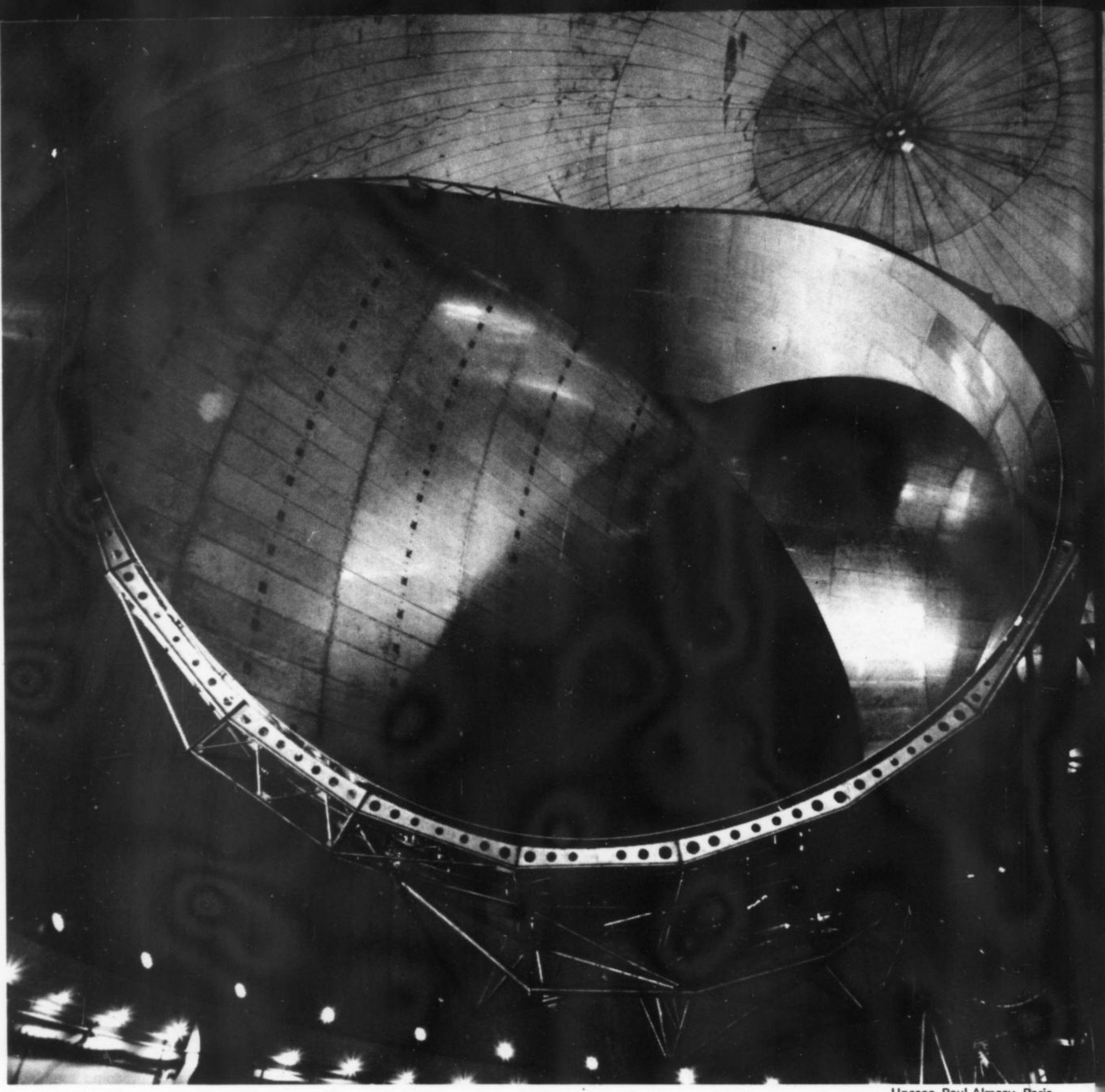


Unesco-Paul Almasy, Paris

WORLD COMMUNICATIONS *(Cont'd)*

From carrier pigeons to satellites

with a great gain in speed, versatility and economy. A major result of these advances is that the need for skilled technicians will be minimized.

Within a decade or two, it seems, only the mass circulation newspapers and magazines will be printed as they are today, though they will doubtless be able to convert to the new processes eventually. The fact that, for the time being, these techniques are particularly suited to small circulation dailies, to weeklies and other periodicals is of special interest to the developing countries.

Newspaper publishing has also benefited from the application of new telecommunication techniques, in association with news agency development. These advances have been made more particularly in the developed countries. In Japan, newspaper and news agency interests undertook post-war research on the facsimile transmission of ideographs, as well as on Monotype and Teletypesetting, as a means of raising efficiency and conserving manpower. This culminated, in 1959, in the simultaneous publication of newspaper editions in Japanese cities hundreds of miles apart.

In 1962 a New York daily went a stage further with the simultaneous publication, by high-speed facsimile and Teletypesetting, of editions in Paris and Los Angeles, the rate of transmitting material being 16 times the normal speed by cable and radio. Later in the year, the same newspaper transmitted several articles, by photo-facsimile, to its Paris edition through the first communications satellite, as well as seven pages to and from the satellite.

These developments, it was foreseen, pointed the way to the simultaneous production of newspaper editions throughout whole regions and, ultimately, of "global

FIRST TRANSATLANTIC LIVE TV VIA TELSTAR

Television experienced a spectacular development in 1962 when the first live programmes were relayed across the Atlantic by means of Telstar, a communications satellite. Eighteen countries in the Eurovision network participated with the United States in these exchanges, viewed by an audience of over 200 million in Europe and North America. The first image across the Atlantic was a shot of engineers at the Bell Telephone Laboratories in the United States (below). This transmission, relayed by Telstar as it circled the globe, was picked up by the giant horn antenna at Pleumeur-Bodou in western France (left) and by a British station at Goonhilly Downs, from where, a few days later, the first transmissions of colour TV via satellite went to the U.S.A.

C.N.E.T., Paris

newspapers." The subscriber would dial a telephone number and the front page of his "paper" would appear on his television screen, remaining there until he pressed a button, when it would be replaced by the second page and so on. He would, in fact, be able to view not only his local newspaper but papers in all countries in this way.

Recent advances in telecommunications culminated on July 19, 1962 in one of the most dramatic events in news agency history. On that day the world news agencies entered the space age by using the first communications satellite to relay dispatches by telephone and teleprinter between continents. London and New York newspapers also exchanged dispatches through the satellite.

It was foreseen that three "stationary" satellites, each orbiting over the equator at a speed synchronized with the rotation of the earth, could provide any type of telecommunication service over the whole globe. Professional organizations of the press, such as the International Federation of Newspaper Publishers and the Commonwealth Press Union, prepared for further developments in the expectation that facilities of this kind would be available to press and other users by 1968.

Ironically, the conditions of modern life have at times forced a return to "new-old" techniques of communications. A somewhat fanciful example is reported by Reuters, which transmitted news dispatches by carrier pigeon in 1850 and by communications satellite in the historic experiment of 1962. The agency states that pigeons have come back as carriers of newsfilm items across metropolitan areas. Pigeons are not worried, as dispatch riders can be, by traffic jams.

Many of the problems encountered in the field of the press do not arise, or are less acute, in radio broadcasting, and the developing countries in particular are giving priority to this medium in expanding their information facilities. Since 1950, the number of radio receivers for every 100 people in all regions has increased much more rapidly than the ratio of daily newspapers. Only two regions, Africa and Asia, now average fewer than five sets per 100 people, suggested as a minimum of adequacy by UNESCO. The Americas, Europe, Oceania and the U.S.S.R. exceeded this level by from 10 to 73 sets on a regional basis.

THERE has been a parallel increase in the number of transmitters. Africa had 140 transmitters in 1950 and 370 in 1962. The number in Europe rose during the same period from 566 to 2,700. The total more than doubled in South America, almost tripled in Asia and almost quadrupled in the U.S.S.R. It is evident that, despite the world-wide challenge of television, radio has a long and active future before it as a medium unsurpassed in speed, range and economy.

Like the press, radio in the developed regions is a well-established medium. But, again like the press, it has experienced many technical changes since 1950 and is on the threshold of new developments.

In recent years the transistor has brought "pocket radio" within the reach of millions of people in all regions. But the transistor receiver is no longer a toy—an object of interest only because of its diminutive size. It is now a high-grade instrument capable of giving both the volume and quality of sound usually associated only with sets having four or five valves and working from power mains.

MEANWHILE, the trend towards "miniaturization", spurred by the revolution in electronics and the development of space satellites, is making for still smaller receivers and other radio equipment. Even now, the transistor is being superseded by microcomponents such as the tunnel diode, which is already in mass production. Within a decade, it is expected by some technical observers, the wrist-watch radio, powered by the heat of the listener's body, will be generally available. Such developments are giving further stimulus to the mass production of low-cost receivers for use in the developing countries. These developments are moving so swiftly as to anticipate the day when there will be one receiver for every family in the world—a target which would at present require over 400 million additional sets.

The past decade has witnessed the increasing adoption of frequency modulation (FM) broadcasting, which provides the listener with a high quality signal relatively free from interference and, moreover, employs hitherto unused very high frequencies in the overcrowded radio spectrum. The experience of a number of developing countries, particularly in Europe and North America, has shown that FM broadcasting for local services is capable of expansion in a way which would relieve much of the present burden in the low, medium- and high-frequency bands and thus improve conditions for national, regional and international transmissions. The introduction of FM

CONT'D ON NEXT PAGE

120 million more TV sets in ten years

broadcasting is therefore of special interest to the developing countries, and particularly to tropical areas affected by solar interference.

Meanwhile, the high quality of FM transmissions has stimulated a whole industry catering to the radio-developed taste for high fidelity musical recordings. Coupled with this has been the development of stereophonic broadcasting which, by using two matched sources of sound, gives breadth, depth and movement to musical, theatrical and other programmes.

AFTER only 27 years since its initial direction to a mass audience, television has established itself as a potent medium of information, education and entertainment throughout the world. It was in 1936 that the British Broadcasting Corporation inaugurated the first public telecasts. The second world war halted television development. But, with the coming of peace, the developed countries began to turn their electronics industries to peaceful purposes.

Television is now expanding with fantastic speed. In 1950, Africa, South America, Asia and Oceania had no television receivers at all. Today, countries in every

A mountain of pulp wood framing the Parliament buildings in Ottawa symbolizes Canada's role as the world's largest producer of newsprint. Publishers in the U,S,A. and Canada consume more than half the world's newsprint production. Demand for newsprint and other printing paper in many of the developing countries is slowly increasing, but still reflects the serious shortage of newspapers and other kinds of printed information in most parts of the world.

© Malak Studio, Ottawa

Deberny et Peignot, Paris - J. Pellerin

A NEW ERA IN PRINTING

A technical revolution is taking place in printing today through the increased adoption of photocomposition or filmsetting in place of the use of raised type. Left, a glass type-wheel in the photographic unit of an ultra-modern electronic photosetting machine. This rotating disc, only 8 inches in diameter replaces three tons of normal lead matrixes. It has 1,440 characters. In operation a stroboscopic light passes through the selected character on the disc into an optical system which projects the light in the form of a type character on to sensitized film. As the light lasts only a few microseconds, the image is "stopped" on the film without halting the rotating disc. The machine is operated from a main keyboard similar to that of a standard typewriter with additional keys for various type composing functions. A second keyboard controls sizes and kinds of type.

region maintain services. The world total of sets has risen from a mere 11 million in 1950 to 130 million in 1963. The number of transmitters has also increased spectacularly during the same period, from 130 to 2,380. For the first time more than half the world total of TV receivers is to be found outside the U.S.A. Europe has registered the greatest increase of all regions—from 15 to 1,160.

INTERNATIONAL programme co-operation has become a regular feature of television development. Most exchanges so far have been made through telerecordings. The direct transmission of programmes across frontiers has progressed rather slowly because of the need for link stations, coaxial cables and converters to permit transmissions on one line definition (number of lines and band-widths) to be received by another system.

However, 18 Western European countries now exchange programmes through Eurovision, sponsored by the European Broadcasting Union, and with the United States. Six Eastern European countries and the U.S.S.R. exchange programmes through Intervision, and also co-operate with Eurovision in programme exchanges. Nordvision links the Scandinavian countries. Bilateral exchanges make available a wide range of other programmes.

Many Asian, African and South American countries are unable to meet production costs for independent programmes, or even the costs of better quality imported programmes. As a result, their television screens often reflect the less impressive cultural standards of "popular" commercial television in the developed countries. Nevertheless, some of the developing countries are boldly imaginative in their use of television facilities for education.

In the field of reception, both small and "full size" transistor sets, which work by battery or off the mains and can thus be used indoors or outdoors, have been developed. It is expected that, as in the case of radio, the transistor will before long be superseded by even smaller components which will make possible the production of diminutive "handbag" sets, operating in colour. Also foreseen is the manufacture of home sets with the picture tube separated from the receiver. These sets would be built into a wall for better viewing.

In the field of transmission, colour television is being actively developed in the United States, Japan, the U.S.S.R. and a number of European countries. Advances are also being made in stereophonic television. Other innovations are the use of video tape—the recording of

CONT'D ON NEXT PAGE

Film shows from outer space

both sound and picture on magnetic tape—rather than slowly-processed film; more "miniaturization" of cameras and, hence, more "live" coverage of news; and the development of the transistorized tape recorder, by which a picture can be seen as soon as it is recorded and thus can be edited on the spot.

A new dimension has meanwhile been given to an old medium through "theatre-vision", described as "a marriage between the living theatre and closed-circuit television". By this means audiences in out-of-town theatres can see plays or operas transmitted hundreds of miles by telephone from a city theatre and projected on large cinema screens.

THE most spectacular development in television history was the relaying, in 1962, of live programmes across the Atlantic by means of the first communications satellite. Eighteen countries in the Eurovision network participated with the United States in these exchanges, viewed by an audience of over 200 million in Europe and North America.

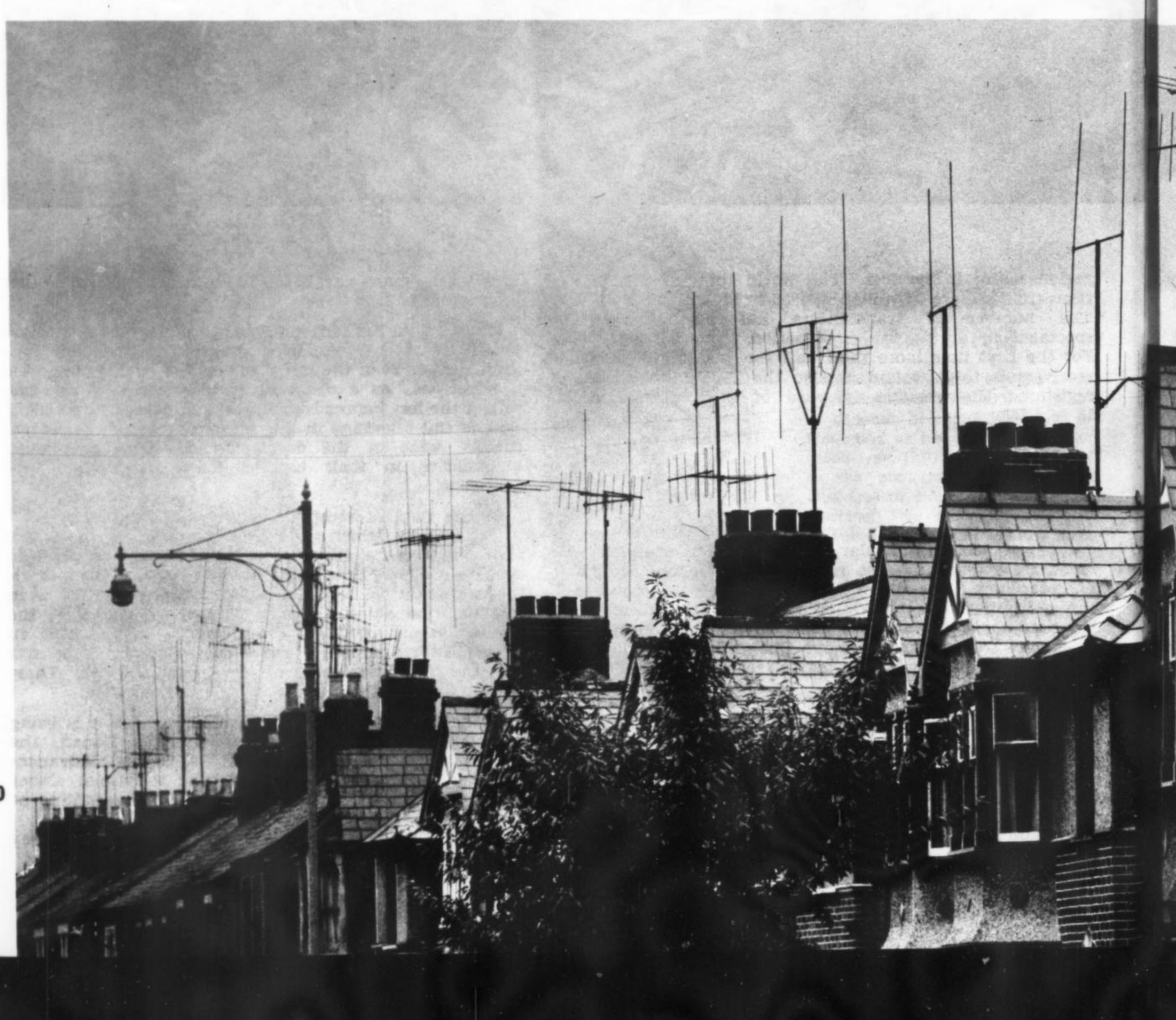
During the first four months of the satellite's operation, 47 intercontinental transmissions were conducted, including five in colour of remarkable clarity. This inspiring co-operative effort pointed to the coming of world television, with all the diversity and enrichment it will hold for the viewer of the future.

Apart from a few countries, mainly in North America and Europe, where television has developed most extensively, the cinema has continued to expand both in terms of film production and exhibition and has retained its pre-eminent role in the world of entertainment. Since 1954, an increasing number of countries have entered into film production and, at the same time, the total number of fixed cinemas has doubled—from over 100,000 to 212,000. Their present weekly audience of 376 million equals one-eighth of the world population.

The principal gains were scored by the U.S.S.R. and the developing countries, where mobile units further expanded the cinema audience. Throughout most of Africa and Asia, however, the number of cinema seats still fell below the level of two per 100 persons, suggested as a minimum of adequacy by UNESCO.

For several decades the United States, which still maintains a predominant role in world markets, was the largest producer of feature films. Since the mid-1950's, however, American output has trailed behind that of Japan, India and Hong Kong. In 1960, there were 26 countries which produced 20 or more features annually. They included 12 in Europe, 8 in Asia, 2 in North America, 2 in South America and 1 in Africa, plus the U.S.S.R.

In the production field, there have been significant



© Jan Lukas, Prague

Forest of TV aerials sprouting on the urban skyline in Great Britain (left) reflects the fantastic expansion of television since 1950—the world total of receivers has risen from 11 million to 130 million. Apart from a few countries, mainly in North America and Europe, where TV has developed most extensively, the cinema has also continued to expand both in terms of production and exhibition. Significant advances in the techniques of film production (above) have also been made and are helping the cinema to retain its pre-eminent role in the world of entertainment.

© Paul Almasy, Paris

advances in camera design, with the accent on 70 mm. cameras for "wide screen" films which put the viewer completely into the environment of the picture. Of special interest to amateurs, research workers and other specialists has been the contrasting development of 8 mm. cameras with sound. Advances have also been made in the production of colour films for screening both in cinemas and on television, as well as in stereophonic sound and optical systems which assure better images for both of the media.

ANOTHER development, of particular interest to tropical and semi-tropical countries, is the production of projectors which use the sun as their source of light and can be employed to screen filmstrips in remote, non electrified areas.

New types of cinemas, such as "drive-ins" for motorists and "theatroramas," are making a fresh appeal to potential cinemagoers and, as in the United States for example, are helping the industry to regain part of the audience lately lost to television. Some of these units, located in new suburban shopping and recreation centres with adequate car-parking space, have been more specifically classified as "drive-to" cinemas.

The development of closed-circuit television, which links groups of cinemas for the screening of special events, presages the time when the projection booth for hundreds of halls will be located in a single television station. These and other advances point the way to the gradual integration of the cinema with television.

This is, in fact, already being realized in the realm of space technology, where narrow- and wide-angle television cameras are being increasingly employed in communications, metereological and astronomical satellites, as well as in space exploration vehicles. The screening of film images transmitted directly to the earth from outer space may be expected to give further stimulus to what has been described as "the renaissance of the cinema".

Photos : Unesco-Tamagawa Gakuen, Tokyo

Above, young programme producers at work in the radio studio of the Tamagawa Primary School, Tokyo, Japan. Nowadays tape recorders, microphones, TV, films and other audio-visual aids are familiar classroom items in all parts of the world, giving new scope and interest to education. Right, children from the same Japanese school listen to language lessons on tape.

NEW SIGHTS AND SOUNDS IN THE CLASSROOM

by Anne Darnborough

THE sights and sounds of radio, television, newspapers and film are today becoming as familiar in classrooms around the world as blackboards and chalk—in some cases even more so.

Increasingly, the dual role of the mass media in information and education is being recognized throughout the globe. The developing countries, where the lack of communication and educational facilities is greatest, realize that the new audio-visual aids can revolutionize the teaching of subjects as varied as languages, geography and science.

World Communications a recent UNESCO report (see page 4) shows how these media are being used today: by some countries to enrich already adequate schooling, by others to supplement inadequate teaching resources and elsewhere to bypass the barriers of illiteracy, or to combat it directly.

Rural areas of less developed countries, the poorest in means of communication, are also generally those with the fewest schools.

This fact underlines the crucial role of the mass media in promoting education as well as economic and social advancement generally. Unsurpassed in speed, range and impact, the mass media offer unlimited possibilities for providing both technical as well as general education on a broad scale.

This is why many African governments are encouraging the development of a rural press to reinforce their literacy programmes. Ghana and Nigeria, for example, print weeklies for country areas, mostly in vernacular languages.

Radio's possibilities in education are being widely explored. The developing countries are giving priority to this medium and the more developed countries are extending its scope.

Almost every South American country now uses radio as an educational aid. Radio "schools" in Colombia reach 170,000 elementary school listening groups each day. The Peruvian government stations as well as 14 independent stations regularly transmit educational programmes. Private stations in Chile are required to broadcast the Ministry of Education's school and popular educational programmes which are compulsory listening

for all schools. The Argentine Education Ministry uses the national radio system to broadcast to more than 300 schools daily. In Central American countries, commercial stations must provide free time for educational broadcasts to schools and for public interest, cultural and new programmes.

Educational programming is a major feature of Asian broadcasting. Two recently established "radio and TV universities" in mainland China have enrolled 19,000 college students. All-India Radio has established 2,000 radio farm forums throughout the country and broadcasts special programmes to some 18,500 schools. Radio Pakistan transmits special educational programmes for adults in local languages from all stations.

Nearly all European countries broadcast to schools and lay varying emphasis on educational and language programmes for the general public. Poland's University of the Air enrolls some 200,000 student listeners. Denmark conducts an "Evening High School" and a "Sunday University". The BBC's London and Far Eastern services transmit 150 "English by Radio" lessons a week, in the world's biggest language-teaching operation.

In the United States there are 187 non-commercial educational stations operated by universities and state and municipal authorities.

Educational programmes are broadcast on a regional basis in the U.S.S.R., and in Australia are received by 94 per cent of schools.

Television is not yet widespread in the developing countries but those using it give an important place to educational programmes. Western Nigeria, for example, broadcasts three hours daily for schools and finds that these programmes are widely viewed by the general public as well. Educational programmes form one-sixth of Kenya's service. Northern and Eastern Nigeria also concentrate on educational broadcasts. The Rhodesian service is under contract to provide school programmes regularly.

In Chile, all stations are educational and operated by universities. Venezuela's one government-owned station broadcasts educational and cultural programmes for about six hours a day.

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TV lessons in 24,000 Japanese schools

All-India Radio broadcasts courses in science, English and Hindi for secondary schools from its experimental transmitter. Japan, in contrast to most Asian countries, has a highly-developed TV network and its educational programme, which covers 42 per cent of the population is received in 24,000 schools. In Oceania, an extensive educational service is being organized for American Samoa.

In the United States, more than 60 educational stations are run non-commercially by schools, universities and foundations. TV instruction beamed from transmitters in high-flying aircraft and covering 78,000 square miles has been developed, indicating what communication satellites might do on a much larger scale for educational broadcasting.

Television for schools is receiving increasing attention in Europe and has been particularly well-developed in Italy and the United Kingdom. In the U.S.S.R., a high percentage of viewing time is devoted to educational programmes for children and adults. The "People's University" programme offers courses in science and technology, arts and English.

DOCUMENTARY and educational films have spread throughout the world and are being produced in increasing numbers by feature film producers, government agencies, industrial concerns, foundations and various non-profit organizations of a cultural, scientific or educational character. In many countries, the film has become an accepted part of the school curriculum, sometimes being used to enrich an already adequate course of instruction, sometimes to supplement instruction where there is a deficiency of textbooks, equipment and qualified teaching staff. With the aid of mobile units, educational and documentary films reach audiences previously uninfluenced by the cinema. Throughout Africa, Asia and Latin America, these units find their way to remote villages whose inhabitants can often neither read nor write. Particular use of these mobile units is being made in Africa.

In South America the employment of films for education in rural areas is mainly in the planning stages. In Asia, the cinema is regarded mainly as an entertainment medium. However, Japan, India and Israel all have outstanding information film services.

While many European countries use the film for educational purposes to a limited extent, only a few countries, such as Finland and the Netherlands have made it an integral part of school curricula.

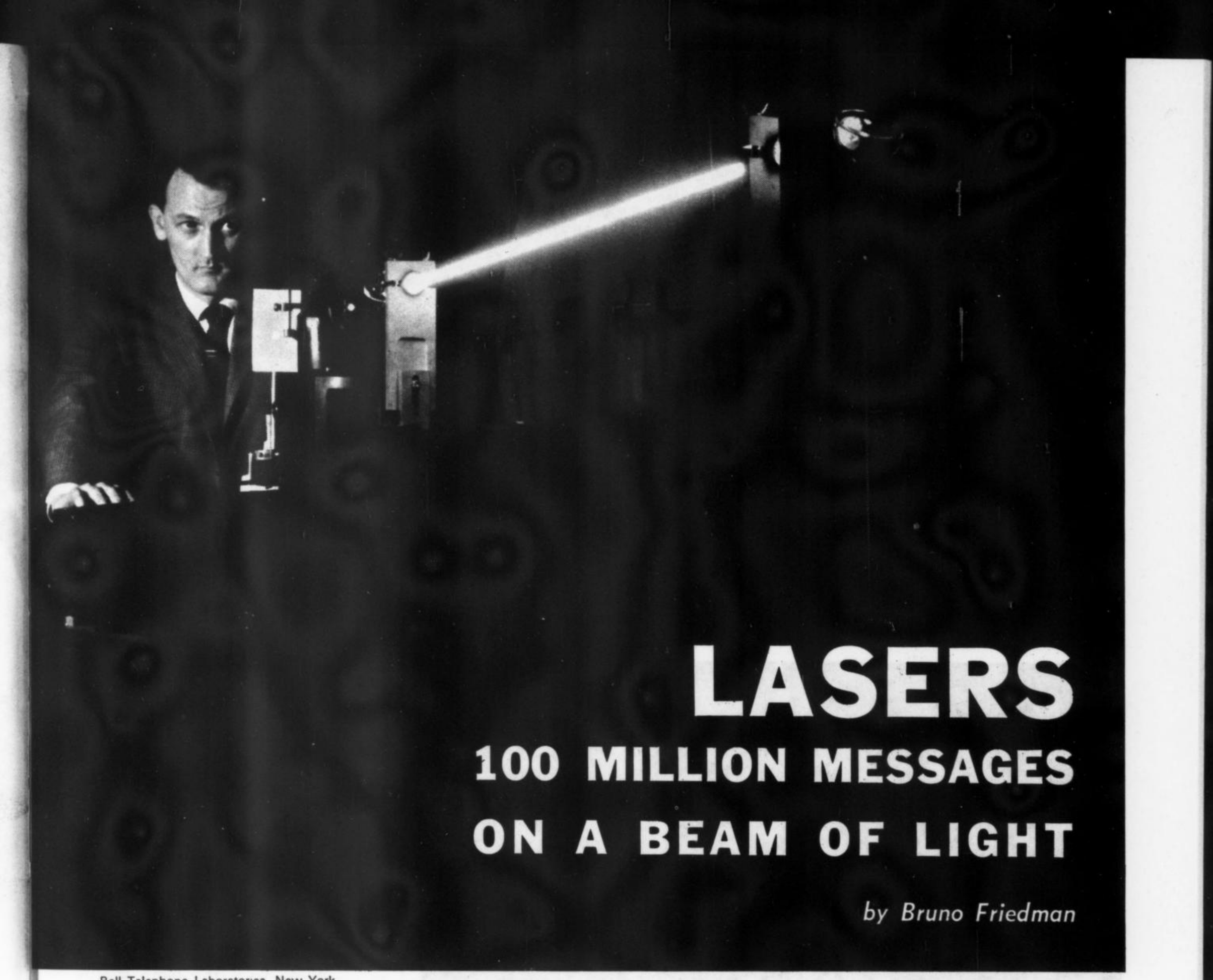
Canada has one of the world's most highly-developed educational film services and widespread use is also made of such films in the United States. Cuba, Australia and New Zealand, among other countries, maintain units for the production of short information films.

The U.S.S.R. produces several hundred instructional films yearly and 23,400 mobile units screen them throughout the region.

In a foreword, *World Communications* draws attention to the programme UNESCO has undertaken at the request of the United Nations to help the developing countries build up their mass media. The United Nations emphasized that the information media have an important part to play in education and in economic and social progress generally and that new communication techniques offer special opportunities for spreading education swiftly.

A TV history lesson for Italian schools makes a greater impact because of its authentic classroom atmosphere. Cameras switch from teacher and blackboard to a live class in the studio. These lessons are part of a three-year course of vocational education for boys and girls who have completed their primary schooling.

Unesco-Eric Schwab



LASERS

100 MILLION MESSAGES ON A BEAM OF LIGHT

by Bruno Friedman

Bell Telephone Laboratories, New York

Lasers produce a visible light beam one million times more intense than the light of the same colour emitted by the sun and offer great promise in many fields. Here a scientist checks a helium-neon gaseous laser.

OUR modern technology, all aspects of our highly technical civilization, may be poised for a forward surge that is unimaginable in scope. All this is based on the re-stimulation of an old science, the science of light, by a new device, the "optical maser" or "laser". So new is this device that is first prototype was put into operation less than three years ago.

A laser does this: it produces a narrow beam of light, which is "monochromatic"—of a single, sharply defined colour or wave length—and "coherent", that is, with all the light waves marching in regular order, like the waves of a smoothly running sea. Light with these characteristics has never before been available to man. Being available now, it opens the way to major developments in communications, radar, surgery, power transmission without lines, and so on. All the possibilities have not even yet been imagined.

These possibilities are particularly amazing in the field of communications. A single laser-produced light beam has inherently the ability to carry all the information transmitted by all the television stations, radio stations, teletypewriters, and telephone lines in the world, operating at the same time. Developing the technical means to use this amazing message-carrying ability is a major problem facing scientists; but the first steps have already been taken. Television pictures and voice messages have already been experimentally carried on light beams.

Light for communications will come just in time. The entire radio spectrum is already vastly crowded. Moreover, the demand for additional communications channels will multiply many times during the next decades.

Lasers were theoretically predicted in the United States in late 1958 by Dr. C. H. Townes of Columbia University and Dr. A. L. Schalow of Bell Telephone Laboratories. The first operating laser, built in 1960 by Dr. T.H. Maiman of the Hughes Aircraft Corporation, was followed rapidly by others.

The essentials of a laser are simplicity itself. The first and best-known one, the ruby laser, consists of a synthetic ruby rod, less than a centimetre in diameter and 10-40 cm. long. This is surrounded by a tubular lamp, wound around it in the form of a spiral. Lighting up the tubular lamp causes a narrow pencil of bright red light to emerge from one end of the rod. This is the laser beam and it is a million times more intense than light of the same colour emitted by the sun. It is visible to the naked eye 40 kilometres away.

But what happens to the atoms within the ruby rod is even more significant. In the planetary model of the atom electrons revolve in orbits around the atom's central nucleus. These orbiting electrons can shift to higher-

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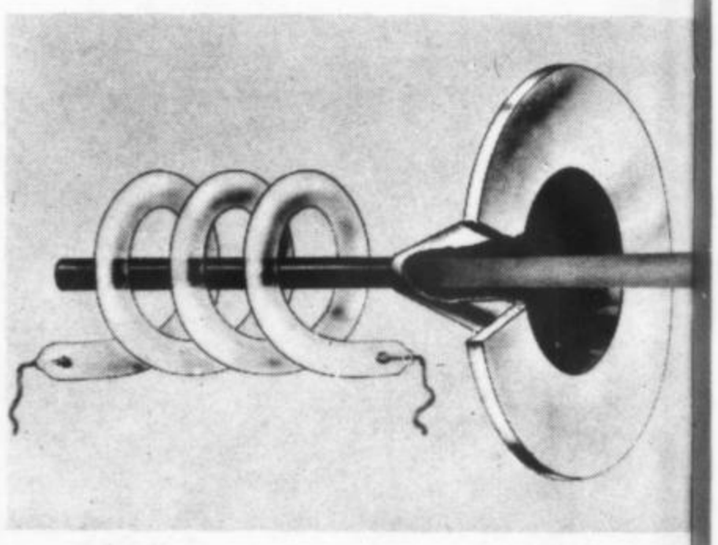
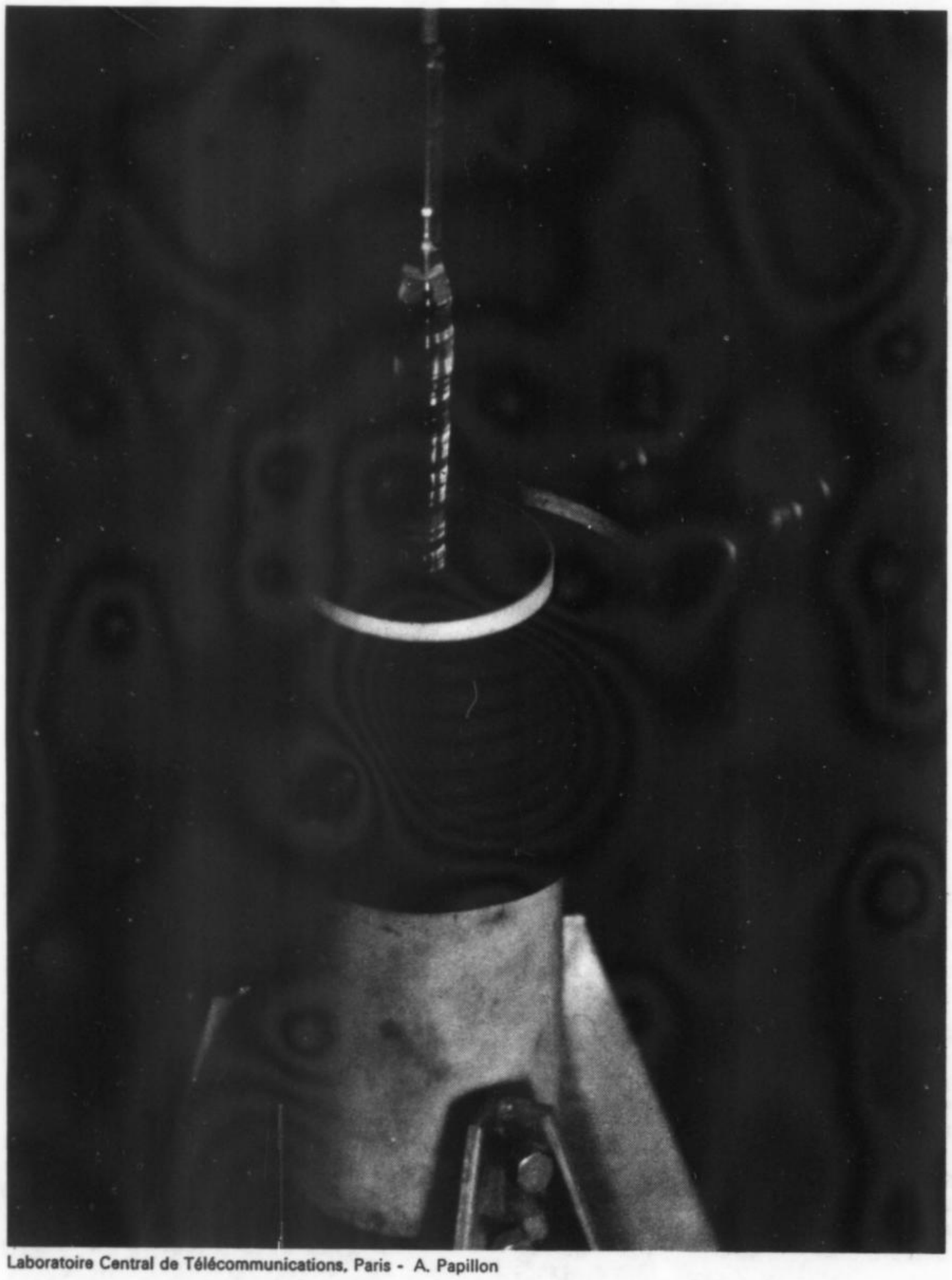
Photos : Bell Telephone Laboratories, New York

Right, sparks fly as red light from a ruby laser drills a tiny hole clean through a steel plate 3 mm. or 1/8 inch thick. (Enlarged detail is shown on front cover). Laser beams have also been used to drill holes in diamonds which are the hardest substances known to man. Left, a vital part of an early model of the helium-neon gaseous laser. Laser beams may one day be used to carry vast numbers of simultaneous telephone conversations and also TV programmes.

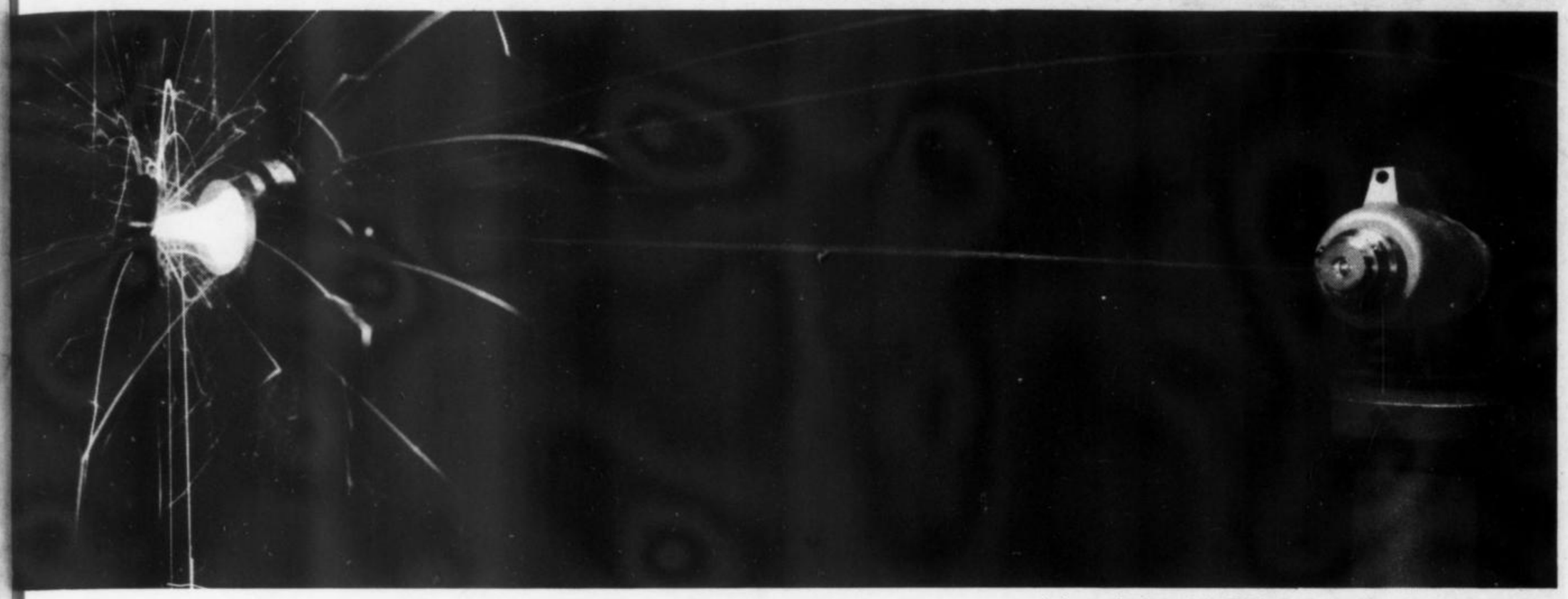


Above, a cutaway drawing shows the "heart" of a ruby laser—a synthetic ruby rod surrounded by a spiral lamp. Light from the lamp stimulates the atoms of the ruby. These store up light and then suddenly release it, producing "coherent" light, that is, of waves that are all synchronized and travel in almost perfectly parallel beams.



Laboratoire Central de Télécommunications, Paris - A. Papillon

Left, a newly-made synthetic crystal being withdrawn from an electric furnace. It will be used in the place of a synthetic ruby in laser experiments. Most laser light is deep red, but scientists hope to produce other colours such as blue-green which could be used, for example, to throw probing beams into the sea's depths. Experiments are now being carried out with a laser using a fluorescent liquid instead of a ruby.



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A revolution in communications

energy orbits, farther away from the nucleus, by absorbing light. They can also shift back again to their original orbits, in this case emitting light. The light they absorb and the light they emit are both of a very specific colour, though not the same colour.

The ruby is composed of aluminium oxide (alumina) plus a very small sprinkling of chromium atoms. It is the electrons in the chromium atoms which do the shifting of orbits. From the light of mixed colours produced by the tubular lamp they absorb green light and go to higher-energy orbits. Some of these higher energy electrons now spontaneously drop back to their original orbits, emitting red light. This released red light stimulates other electrons, which are still in their higher-energy orbits, to fall back to their original orbits, also emitting red light.

It is this stimulated release of light which gives the laser its name, made up of the first letters of the words "light amplification by stimulated emission of radiation."

The laser-produced light has the very important characteristic of "coherence." This means that the waves composing the light flow in completely regular sequence, like smoothly running ocean waves. Radio waves have this coherence. Such regular waves can serve as information or message carriers. Thus, at the transmitter, the complete regularity of the carrier waves can be varied electronically, the variations representing a television picture or a voice. At the receiver, the variations from complete regularity of the carrier waves are noted. These variations are then transformed back into reproductions of the original voice or picture.

Coherent light has inherently such great message-carrying capacity that theoretically millions of messages, such as television pictures or telephone conversations, could be imposed on it, rather than merely one message. This follows from a simple rule: the information capacity of a carrier is proportional to its vibration frequency. Since the frequency of light is something like a hundred million times as great as that of radio waves, its capacity for carrying information is correspondingly great.

A laser beam, already extremely narrow, can be converged even more by lenses. In 1962, scientists of the Massachusetts Institute of Technology and the Raytheon Corporation sent a beam through a telescope—so that it emerged through the small end—to the moon. Here it made a spot of light only 3 km. in diameter. Laser beams have also been converged to a fine, hot point by microscope lenses, making an ultra-fine scalpel to painlessly remove a tumour from the retina of a human eye.

The original ruby laser emits light in very brief pulses. For communications purposes a continuous beam will be required. Such laser beams have already been produced from gases and from various solid materials. These produce light of various frequencies, in the infra-red as well as in the visible range.

Opening one's imagination to to-morrow can suggest remarkable things from laser light. For example, imagine a system of communications satellites orbiting the earth. Properly distributed, just a few such satellites could relay all the messages—radio, television, cable, telephone—passing between all the continents of the globe, transmitted on very few light beams.

This fine picture has flaws. For one thing, the extreme narrowness of the light beams creates problems in aiming at and hitting a small target. However, electronic computers will doubtless be able to handle this problem.

More difficult to handle is the interference of clouds, mist, fog, and smoke. This difficulty may be met to some degree by using infra-red light, which penetrates clouds and mist more readily than visible light; also, by locating light-projecting stations in arid regions, with good year-round weather conditions; and by having auxiliary stand-by stations for times when the main stations are closed due to bad weather.

Another possibility is to send the laser beams along the ground through wave guides, which are simply pipes enclosing a vacuum. Repeater stations located on the wave guides at intervals, say, every 100 km., will amplify the partially faded light beam and re-transmit it to the next repeater station.

It is easy to imagine such wave guides running across continents, with a single beam in the guide serving as the equivalent to hundreds of thousands of telephone cables.

Laser light may be used for communications with colonies on the moon or on planets or with men in spacecraft —or between spacecraft. But the problems of aiming and getting sufficient power output from a laser must be met, for adequately powerful continuous-beam lasers do not yet exist. It may also be noted that the tightness of the laser beam has certain other characteristics. It will be impossible, for example, either to intercept messages or to jam transmissions.

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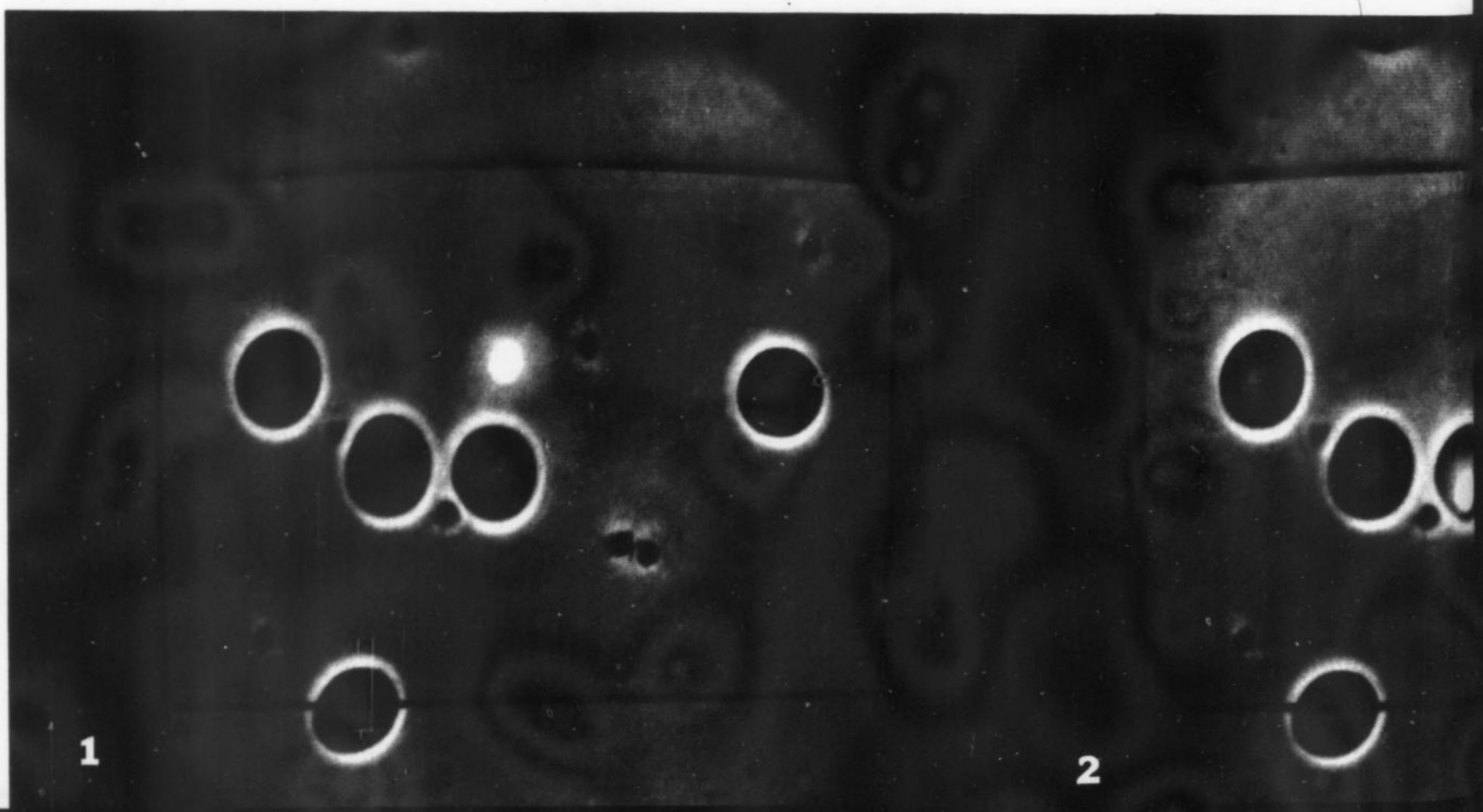
A REVOLUTION IN SURGERY

These remarkable pictures show how light from a ruby laser helps scientists at France's National Blood Transfusion Centre in Paris to study body cells. Right, the equipment they use: a closed-circuit TV installation, a ruby laser and a powerful microscope. Photos below show the amazing precision they obtain from the "coherent" light which can be used by a surgeon as a micro-scalpel.

(1) Red blood corpuscles placed under the microscope are photographed by the TV camera and their image is relayed to the screen shown on right. A spot of normal light is used to "zero in" on one of the corpuscles. (2) A flash of laser light lasting about one-thousandth of a second then scores a bulls-eye on the corpuscle. (3) As soon as it is hit the corpuscle changes colour and begins to dissolve. Dark patch is the point of impact and appears to be coagulated hæmoglobin.

CSF, Paris - Georges Bru



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In a workshop in El Khalil (formerly Hebron), a master craftsman keeps a watchful eye on the molten glass in his ancient brick furnace. Today as in past centuries, this city of western Jordan is famed throughout the Middle East for its glass production. Using techniques unchanged by time, its craftsmen make a jewellery of translucent glass with a predominantly blue-green tint. Ancient Hebron ranks among those of the world's oldest cities that are still inhabited.

© Paul Almasy, Paris

Craftsmen of the
Phœnician coast

3,000 YEARS OF GLASS-MAKING

by Anita Engle

Roman vase discovered in a burial cave on Mount Carmel.

© Keren Hayesod, Jerusalem

THE period covered in this article extends from the first recorded references to glass-making on the Phœnician coast in the 15th century B.C., until the ancient industry was brought to an end in the 15th century A.D. by the Mongol invasion which destroyed the ancient patterns of life all over the Middle East.

No matter to what sources one turns for enlightenment on the origins of glass-making, whether legend, mythology or history, one is invariably brought back to the Phœnician coast. Archæology too corroborates that the area, which in ancient times extended south of the bay of Acco (Acre) and north of Byblus, was active in the manufacture of glass from a very early period.

This is not surprising, when one realises that the origins of glass-making are tied up with the beginnings of metallurgy. From 2,600 B.C. onwards, the narrow strip of Canaan known as Phœnicia was acting as a long bridge between Mesopotamia, the cradle of technology, and Egypt, the ever-open market for goods, ideas and craftsmen. It was no one-way traffic. The glass industry, like that of the bronze, ivory, dyeing and textile industries, was subject to a constant interplay of influences and stimuli between Mesopotamia and Egypt, as sometimes one country was in the ascendency, and sometimes the other.

It may never be possible to ascertain whether or not the craft of glass-making actually originated at the mouth of the Belus. Nevertheless, it remains a fact that the oldest traditions of glass-making that have come down to us are centered on this mysterious little river, today called the Naaman, in Western Galilee.

The classic association of the River Belus with glass-making is to be found in Pliny's Natural History. Pliny has been so maligned—and so misquoted—that it is worth giving his perfectly reasonable statement in full. It has been taken from the 1962 translation by Eichholtz in the Loeb Classical Library, Book XXXVI.190.

"That part of Syria which is known as Phœnicia and borders on Judea contains a swamp called Candebia on the lower slopes of Mt. Carmel. This is believed to be the source of the River Belus, which, after traversing a distance of five miles, flows into the sea near the colony of

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The 'molten stone' of the Pharaohs

Ptolemais (Acco). Its current is sluggish and its waters are unwholesome to drink, although they are regarded as holy for ritual purposes.

"The river is muddy and flows in a deep channel, revealing its sands only when the tide ebbs. For it is not until they have been tossed by the waves and cleansed of impurities that they glisten. Moreover, it is only at that moment, when they are thought to be affected by the sharp, astringent properties of the brine, that they become fit for use. The beach stretches for not more than half a mile, and yet for many centuries the production of glass depended on this area alone.

"There is a story that once a ship belonging to some traders in natural soda (natron, an Egyptian product) put in here and that they scattered along the shore to prepare a meal. Since, however, no stones suitable for supporting their cauldrons were forthcoming, they rested them on lumps of soda from their cargo. When these became heated and were completely mingled with the sand on the beach a strange translucent liquid flowed forth in streams; and this, it is said, was the origin of glass."

Pliny takes no responsibility for the story about the origins of glass-making. He is merely repeating what was "common knowledge" among the Greeks for centuries before his time. This story may well be one of the many travellers' tales circulated after the Greeks began their contact with Egypt in the 7th century B.C. For it is from Egyptian sources that we have the first documented indications of glass-making on the Phœnician coast.

They were not writing about glass as such, unfortunately. Glass merely makes its appearance incidentally, as part of the vast booty which the Pharaohs of the 18th Dynasty began to bring back from Syria and the Lebanon after Tuthmoses III's dramatic capture of Megiddo in the 15th century B.C. The lists of items, and their places of origin were engraved on the walls of the temple of Amen-Re, at Karnak, where Tuthmoses deposited his booty.

From the Phœnician coast came "green stone, every costly stone of the country, and many stones of 'sparkle'..." The latter is a mysterious hieroglyph referring to a costly stone, and having a fire determinative. In other words, a "molten stone."

This sparkling molten stone must have been a translucent glass, and of a type peculiar to Phœnicia, for we have other references to glass as it was known in those days; namely, the blocks and pieces of "artificial lapis lazuli from Babylon" which the chiefs of Assur and Shinar sent to Tuthmoses III as indications of their good will.

The earliest vessels of glass known to us, the beautifully-

Grape-cluster glass vessel from Sidon, dating from the 3rd Cent. A.D.

© Frederic Neuburg

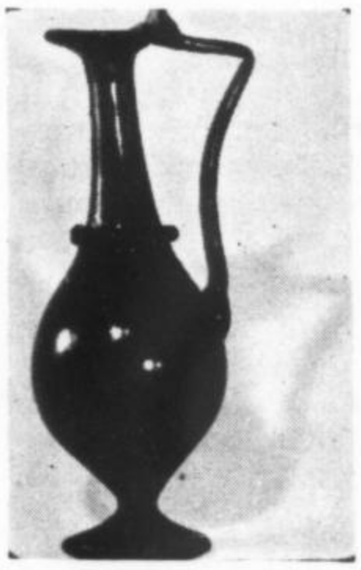
TREASURES IN THE SAND

The oldest traditions of glass-making seem to be linked with the banks of the Belus, a little river today called the Naaman, in western Galilee. Pliny, the Roman naturalist, relates that some merchants encamped on the sands of the River Belus placed their cooking pots on blocks of soda and that the heat from the fires fused the sand and the soda to form glass. What is known for a fact is that the ancient Syrian glass-makers found the sands in this area ideal for their work. Left, the former course of the Belus before it was diverted 20 years ago during the draining of nearby swamps, the home of water buffaloes (right).

Photos © Keren Hayesod, Jerusalem

coloured little cosmetic jars of Egypt, only begin to make their appearance after Tuthmoses III conquered Phœnicia and Syria. They reached their highest development and eventually declined within the 200 years that the Egyptians used the Phœnician harbours as bases from which to keep the annual tributes of precious commodities, artificers and slaves flowing from the merchant princes of Canaan.

Both to honour the peoples of the conquered territory, as well as to provide a record of their own magnificence,



Roman vase in green-tinted transparent glass.

Haaretz-Museum, Tel-Aviv

the Pharaohs set up shrines to their own gods and monuments to themselves alongside the local sacred sites. The closeness of Egyptian contacts with the River Belus is seen in the Memnon monument, a statue in honour of Amenophis III, which was still standing at the mouth of the Belus in the 1st Century A.D., when Josephus mentions it. Perhaps it resembled the two colossal statues of this self-aggrandizing monarch which can be seen today on the plain West of Thebes.

The Egyptians did further honour to the sacred, glass-sand-producing river of the Canaanites by giving it the same name as their holy Nile. "Sehor" they called it, which means the water of Horus. This is the Shihor Livnat which we find cited in the Bible as the border between the tribes of Asher and Zebulun.

Glass to the ancients had a deeply mystic significance. The glass paste, therefore, the objects made from them, and the beautiful but limited range of colours introduced into them, were so highly valued because of their religious significance. The place where the item was made, or even where the sand came from, would be part of its mystic value. It is not necessary to go into the Osiris-Adonis cults which were associated with the River Belus to understand how the processes of glass-making would be taken to symbolize the soul's transformation into beautiful, imperishable life, after the dross of the body had been purified by the flames. Nor why the superstitious would feel that a jar of this magically-tinted glass in the tomb with them was an assurance of immortality.

The formative period in glass-making in Egypt was under Amenophis II, who followed up his father's campaigns in the Lebanon, returning with more treasures and slaves. Supplies from the Phœnician coast were vastly augmented by grandson Amenophis III, from whose reign, and that of his son, Akhenaten of Tel Amarna fame, we have the most plentiful supplies of ancient Egyptian glass.

Like the other imported treasures, the glass, in whatever form it came, and the enslaved artificers, would be sent to the temple of the god, or to the mortuary temple of the Pharaoh himself. There would be small workshops attached to the temples, for we find the high priest of Memphis bearing the title "director of the glass factory."

It is interesting to speculate whether among the slaves who escaped from Egypt with the Children of Israel were descendants of those craftsmen which the illustrious 18th Dynasty records having brought in such quantities from Phœnicia over a period of 200 years.

If so, the ex-slaves may well have rejoined their kinsmen on the Phœnician coast, for it is here, in the area of

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Fiery furnaces of Babylon

the River Belus, that we find the first reference to glass-making in the Bible.

This is in Deuteronomy 33, which records the blessing which Moses bestowed on each of the tribes before his death. In Verse 19 the seafaring tribe of Zebulun, here linked with that of Issachar, is assured that "they shall suck of the abundance of the sea, and of treasures hid in the sand."

The Midrash, which is a collection of oral legends, derived from many sources and going back to remotest antiquity, elaborates on this. Zebulun, it is related, once complained to the Holy One: "Lord of the Universe, to my brethren you gave beautiful land, and to me you gave the sea. To my brethren you gave fields and vineyards, and to me you gave sand." To which He answered: "Yes, but did I not give you the snail (the purple murex) ? Did I not give you glass?"

Although traditions older than recorded history are embodied in the Blessings of Moses, it is, nevertheless, possible to extract certain facts. The noted Biblical exegete, the late Prof. Robert Pfeiffer, has ascertained that the blessings in Deut. 33 were recorded during the time that the Northern Kingdom was at the height of its power and prosperity under Jeroboam II (785-746). Archæology reveals that industries of various kinds—among them the dyeing industry which, from later Hebrew writings, appears to have been associated with glass-making as a village craft—flourished exceedingly at this period. This would suggest that glass-making was one of the industries of the prosperous Israelites at the time when the Northern Kingdom was finally absorbed by the Assyrians in 721 B.C.

Glass-makers, then, would be among the varieties of craftsmen taken into exile to enhance the splendour of the Assyrian capitals.

Were any of these captive glass-makers from the Kingdom of Israel, or their descendants, among the craftsmen who produced the highly developed recipes collected in Assurbanipal's library at Nineveh, on the banks of the Tigris, some 50 years later? For the time being, one cannot say.

Assurbanipal (668-626), one of the last of the great Assyrian kings, caused to be collected in his capital copies and translations of every important book (clay tablet) to be found in the temple cities of Mesopotamia. These tablets included magical spells for every occasion, treatises

Egyptian mask of "glass paste", made in a mould of carved stone and dating from 1500 B.C.

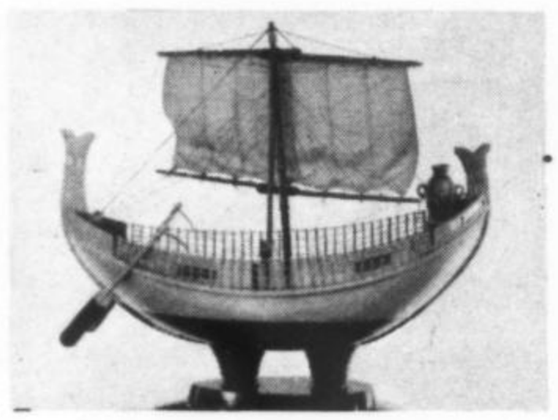
Victoria and Albert Museum, London

on medicine, chemistry, geology, etc. Among them were recipes for making varieties of coloured, gold, and clear glass. There were also instructions to the glass-makers regarding the type of fuel to use, and the manipulation of the furnace.

The Assurbanipal tablets are the earliest literary record of the plant and processes of glass-making. As they are copies, they probably date back much earlier. They reveal a highly developed and unsuspected glass industry in Mesopotamia in the 7th century B.C., some four hundred years after Egypt had faded out of glass history. There is another aspect which is very important for our knowledge of how this industry developed in antiquity.

The tablets reveal, relate Prof. R.J. Forbes, in "Studies in Ancient Technologies" that "by the 7th century glass furnaces had developed considerably in Mesopotamia, and the glass-workers had gone a long way in the battle for sustained and intense heat. Here in Mesopotamia we must see the origin of the reverbatory furnace which is the pre-condition of glass-blowing."

In other words, when they learned how to make a



Model of a Phœnician vessel (1300 B.C.)

Maritime Museum, Haifa

furnace that could maintain a high enough temperature, the glass-makers were able to bring their glass batch to a state of liquifaction where it could be blown into a variety of shapes, instead of merely being wound round a core, or pressed into a mould as previously.

The final development of the Babylonian glass furnaces must have taken place somewhere on the Phœnician coast, for it is here, some 500 years later, that the history of glass-blowing begins. The time lag fits in well with the fact that in the pre-scientific age, the average time-span for new technological developments was about 500 years.

A clue as to how these techniques came from Babylonia to the Phœnician coast can be found in the Bible.

When the Persians, under Cyrus and Darius, became the conquerors of the Middle East, they "turned again the Captivity of Zion" (Psalms 126). The returning exiles brought with them new ideas, new methods of writing (the Hebrew script used today), new art forms, and new techniques acquired during their sojourn in the great cultural centres of the ancient world. Some of these exiles must have been glass-makers who returned to the traditional centres along the Phœnician coast.

The Bible does not refer to the return of these Northern exiles, because the books of Nehemia and Ezra were written by and are concerned almost solely with the doings of the priestly caste centred in Jerusalem. But one can find references to them, the simple people, the craftsmen, in later Hebrew writings, such as the Mishnah and the Talmud, which deal with the laws pertaining to the everyday life of the people, not only within the confines of the Holy Land, but also in the neighbouring areas, such as Tyre and Sidon, or wherever there was a community large enough to maintain a synagogue.

The return of craftsmen to the Phœnician coast may have begun during the time of Darius (521-485). The Bible reports that he encouraged a further return of Babylonian exiles. And it was he who began to co-ordinate the great Persian Empire by establishing new trades, industries and methods of commerce. He aimed at developing the economic structure of his own country, up to then a backwater, and to create means of exchange for the Greek products which the Persians wanted.

Certainly the harbours along the Phœnician coast took

on new life after the Persian conquest and so did glass-making. The majority of the pre-blown vessels to be seen in museum collections belong to this period—from the 6th to the 4th centuries B.C. While similar in many respects to the beautiful cosmetic jars of Egypt's 18th Dynasty, they are in reality quite different from them (and often inferior in colour and form to those made almost 1,000 years earlier).

Achziv, a point on the Phœnician coast some 35 km. south of Tyre and some 16 km. north of the great natural harbour of Acco, must have been one of the centres of glass-making at this time. Although recorded references to it are sketchy, since it was always overshadowed by Acco on the one side, and Tyre on the other, nevertheless Achziv was an important town from early history, and the remains of an ancient harbour are still to be seen there.

Was this one of the old glass-making centres to which the Babylonian exiles returned? There is some evidence to support this belief. The Mishnah refers to Achzib (Chezib) as that part "which they that came up from Babylon in the time of Ezra occupied." And archæological finds indicate glass-making in that area from the Persian period, through the Hellenistic, early Roman, Byzantine and Islamic periods. Apart from the glass fragments scattered everywhere in the area, and some glass slag, complete vessels from Achziv can be found in museums and private collections in Israel, and elsewhere. (In particular, the Haifa Museum of Ancient Art has a collection of B.C. 6th-4th century sand-core vessels all very similar

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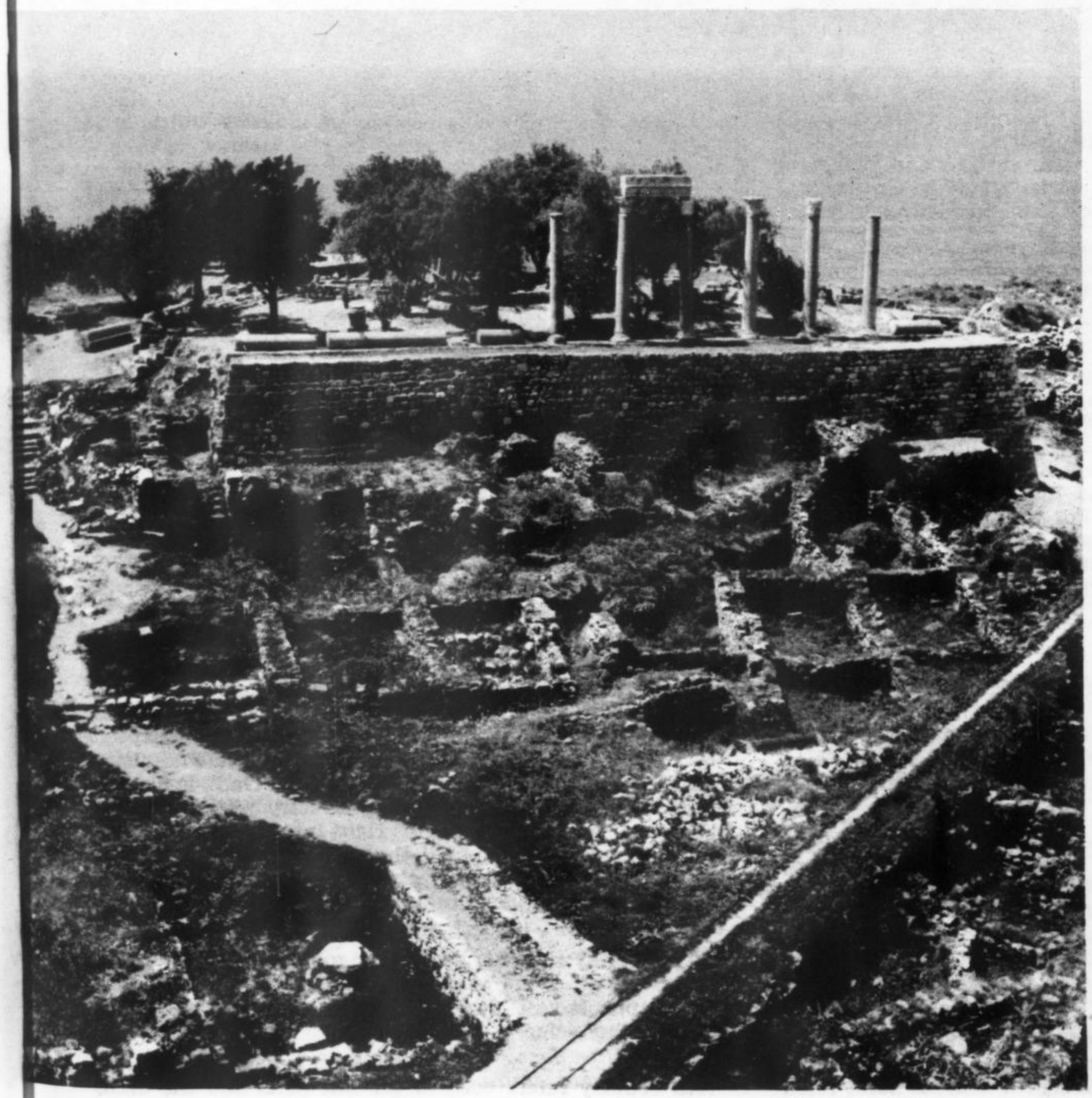
Victoria and Albert Museum, London

A rare example of the early glass-maker's art, this 2nd or 3rd century miniature portrait is engraved or stippled through gold-leaf and backed by blue glass.



Remains of a Roman colonnade at Byblos, the Phoenician port which established trade links with Egypt in early times. Ships leaving Byblos carried wood from Lebanon and glassware from Phœnician workshops.

© Paul Almasy, Paris

Products renowned from Gaul to China

to each other. One of them is labelled "found at Achzib," the others "from the Phœnician Coast").

Tyre would certainly have been a centre of glass-making during the period of 400 years or so that it took for the imported Babylonian furnace techniques to develop into the glass-blowing stage which ushered in the first golden age of glass at the beginning of the Christian Era. However, until Crusader times, records mention only Sidon. This may be due to the fact that during the Persian period, from which time we begin to get direct references to glass-making on the Phœnician coast, Sidon superseded Tyre as the leading city of Phœnicia. The type of many-coloured unguentaria or perfume bottle which is characteristic of the Persian period was widely distributed by Greek traders together with their Attic pottery. Later, they distributed the mould-pressed and lathe-turned vessels which were found in the most far-flung areas of the ancient world during the Hellenistic period. Sidon was probably their chief port of call along the Phœnician coast, and it is indeed the Greeks who made Sidon synonymous with glass-making, with the Phœnicians, and with Phœnicia in general.

By the time the Romans came to the Middle East—that is, around 63 B.C., Phœnicia was widely famed for its glass and glass-makers. That is not to say that they were making the most beautiful glass in the ancient world. The Alexandrian glass-makers were doing that. From Alexandria came the rich gem-like pastes, the vessels carved like rock crystal, and the millefioris. This profitable trade in imitation of the fabulous precious and semi-precious stones of India and the nearer East which reached the Roman market via Alexandria, kept the Egyptian glass-makers tied to their static cutting and moulding processes. This left the Phœnician glass-makers free, in fact eager, to experiment with competitive techniques.

This brings us to the greatest single advancement in the history of glass-making: the blowing iron, which has been rated one of the great discoveries of mankind.

It has been put with admirable conciseness by Mr. W.A. Thorpe, author of "English Glass": "Inflation was developed in Syria, probably at Sidon, about the third to first centuries B.C. It was a commercial development by a commercial people, who wished to enlarge the usefulness of their wares. The Pax Romana gave them their chance, and they took it, and they kept it. When they first made sale for the new wares, the industrial world was still clinging to Greek routine. For a time Sidon manufacturers were tied to shapes and patterns which did not emerge from Syrian glass processes or from the Syrian mind . . . When they blew free, glass became a new art."

By "Greek routine" Mr. Thorpe refers to the vessels made by blowing glass into moulds imitating the shapes and decoration popular in vessels of other materials. For the first time mass production of decorated glass became possible as this new process replaced the tedious work of the older artists.

"Hallmarks" were introduced by these enterprising master craftsmen of the Phœnician coast. Vessels stamped with names like Ariston, Artas, Jason, and Ennion of Sidon became known all over the Roman world. The names were Greek, because Greek names and language had been fashionable since Alexander's conquest 300 years earlier.

Ennion is one of those who is believed to have migrated to Italy, or possibly to have set up a branch there. He is the most famous of the glass-makers, and each of the handful of pitchers and vessels signed with his name fetch several thousand dollars today. Their appeal is only to the connoisseur. The static pressed designs in rather lifeless blue or amber glass look much like our cheaper type of machine-moulded glass, which, fundamentally, is only a sophisticated modification of the ancient process invented in Sidon.

Strabo, who actually visited the area in 25 B.C., verified Sidon's early importance as a glass-making centre by adding that the sand of the Belus was taken there to be "cast" into glass. Twenty-five years after the latest date for the discovery of glass-blowing, Strabo does not appear to know that a revolution had taken place in the art of glass-making.

Sidon would probably have had a large-scale factory-type of production. But not all the glass would have been produced under such circumstances. Home industries must have been the order of the day rather than the exception, and many of the vessels exported from Tyre and Sidon would have been collected by itinerant merchants going from house to house. There is a charming picture in Proverbs XXXI. 24[12] of the woman of worth who "maketh fine linen, and selleth it; and delivereth girdles unto the merchant." In the original Hebrew, the word "Canaanite" is used, not "merchant". "Canaanite" has a dual use in Biblical times, meaning both the inhabitants of Canaan (which included the Phoenicians), and those who dealt in trade.

It is the cottage type of industry which is so vividly illuminated in the Hebrew laws and regulations compiled in Galilee during the first centuries of the Christian Era. They cover almost every aspect of the industry, from the different types of ovens and furnaces, to the sale of the finished items. There must have been a phenomenal production of glass in Palestine at that period, judging from the fragments which one finds in every ploughed field, with endless variations on the theme of the glass-thread decoration. Slag from glass furnaces of the Mishnaic period (from the 2nd to the 5th centuries A.D.) are comparatively plentiful as well. The writer, without making any particular effort, has collected specimens of glass slag from eight sites, six of them in the area of the Phœnician coast.

Among the items made out of glass were plates, bowls, wine and water flasks, trays, pickle and preserve jars, cups, pitchers, vases, perfume bottles, cosmetic jars, milk funnels, urinals, feeding bottles, glass spoons, mirrors, funerary urns, coffins, trays, architectural decorations, including pillars; bracelets, beads, rings.

Like the earlier vessels, the blown glass travelled to Gaul, South Russia, India and China. Presumably it was in the inevitable clay jar that this fragile cargo was transported by ship. by donkey, or by camel caravan. As Mr. Thorpe traces in the introduction and early chapters of "English Glass," the glass-makers of the Phœnician coast followed their markets to Italy and Gaul, laying the foundation of a European glass industry which bore the marks of their ancient origins right into the 16th century. These glass-makers spread throughout Asia as well. All traditions associated with glass-making in the countries of the East, including India and China, claim "Syrian" origins.

In spite of the changes which took place in Palestine and Syria after the Moslem conquest in the 7th century, there appears to have been no cessation of glass-making on the Phœnician coast.

Tyre regained its supremacy. William of Tyre in the 12th century refers both to the fine sand and the many

© Keren Hayesod, Jerusalem

Roman glass vases from burial caves on Mount Carmel, dating from between the 1st and 3rd centuries A.D., reveal graceful forms and decorative styles already achieved by Near East craftsmen.

beautiful vessels famous for their transparency which were "carried to far distant places and easily surpass all products of the kind..."

Benjamin of Tudela also writes about Tyre in the 12th century. He describes it as having a magnificent port, frequented by traders "from all parts," adding: "About 400 Jews reside in this excellent place . . . (they) are shipowners and manufacturers of the far-renowned Tyrian glass..." In Sidon he found some 20 Jewish inhabitants, who were glass-makers, and in Antioch about 10.

By this time Damascus had become the centre of a new development in the Eastern glass industry, the richly enamelled Saracen glass beakers and mosque lamps. But the Belus was still an important source of sand, Sir J. Mandeville recording, during a trip to Palestine in 1322, that "Men comen fro fer watre be shippes and be londe with cartes, to fetchen of that gravelle."

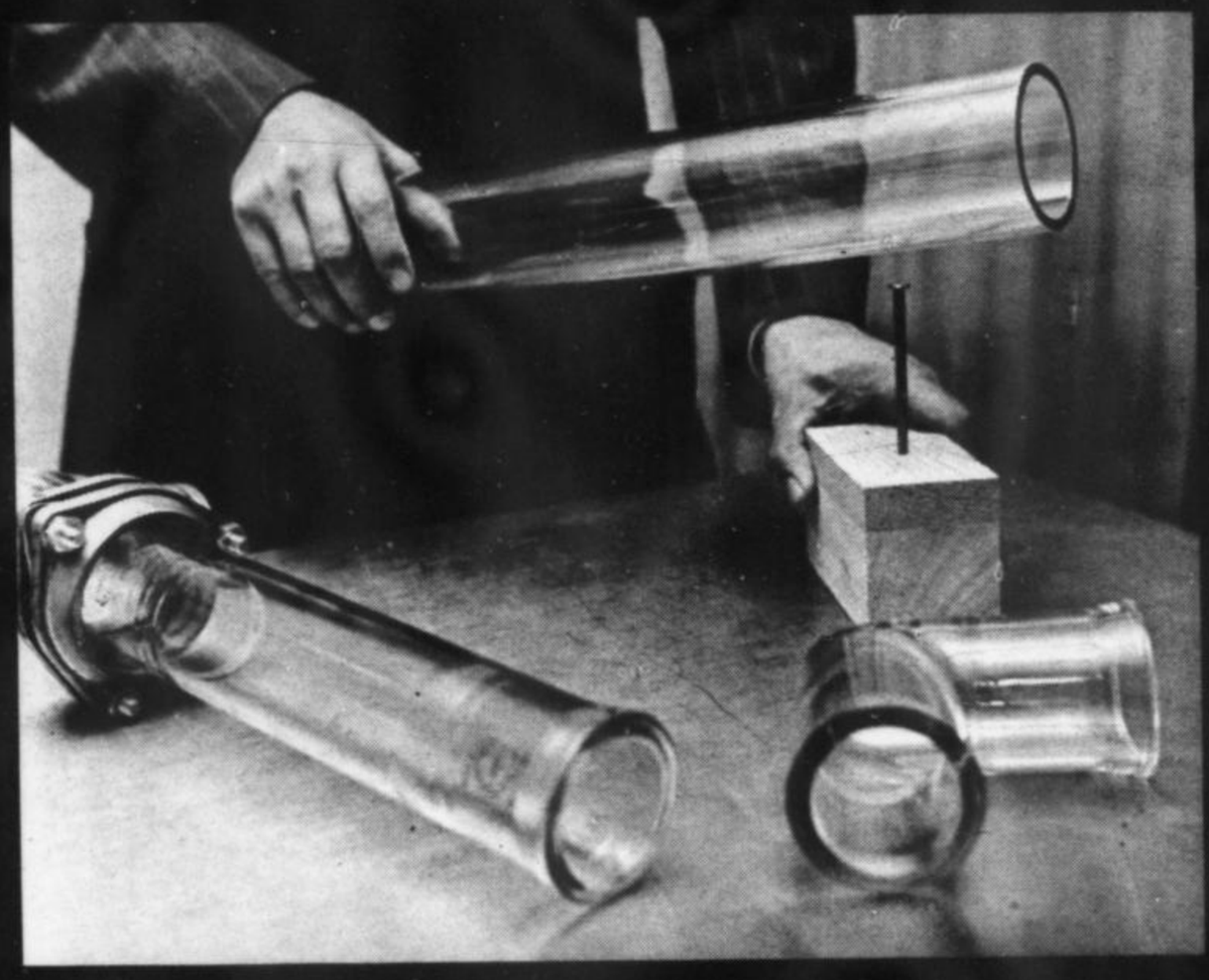
The Venetians provided shipping, services and supplies for the Crusades. In return they secured special privileges and quarters on the East Mediterranean coast. By 1124, at the height of Crusading success, they were firmly established in Jerusalem, Acre, Sidon, and particularly in Tyre. Raw materials together with craftsmen were exported to Venice, and as early as 1224 there was a glass-blowers' guild there.

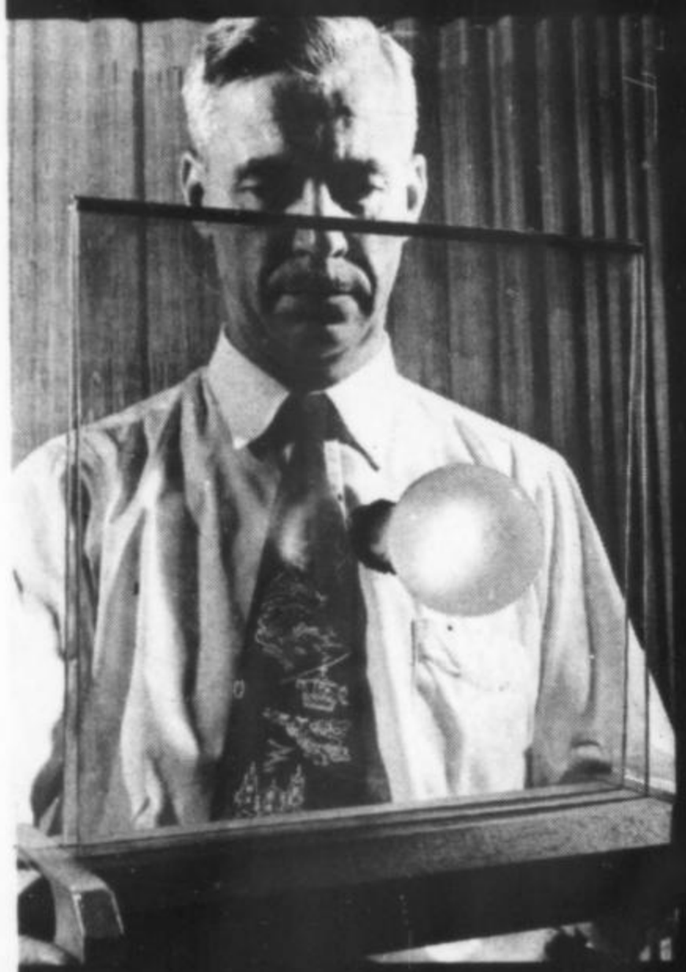
When Tamerlane took Damascus in 1401 and virtually extinguished the Syrian glass industry by deporting its craftsmen to Samarkand, Venice replaced the East as the world's centre of fine glass-making, although it was some two centuries before Venice could begin to rival the wares of Syria.

ANITA ENGLE *is a Canadian-born writer now living in Israel. The above article is a summary of the independent research she has been doing for the past ten years on the history and origins of ancient glass, which is to be incorporated into a forthcoming book tentatively entitled "Cracked About Glass." This will be a Mediterranean-wide survey of ancient centres of glass-making, particularly those areas whese glass-making is still carried on in the ancient manner.*

AMAZING MODERN GLASS

If any of us have tended to take glass for granted the photos on this page should help to set us straight about its amazing versatility. Thanks to modern research glass is now not only shatter-proof and heat-resistant but can be made as soft and smooth as silk or as hard as steel. Right, a glass tube so tough it can hammer a nail into a block of wood.





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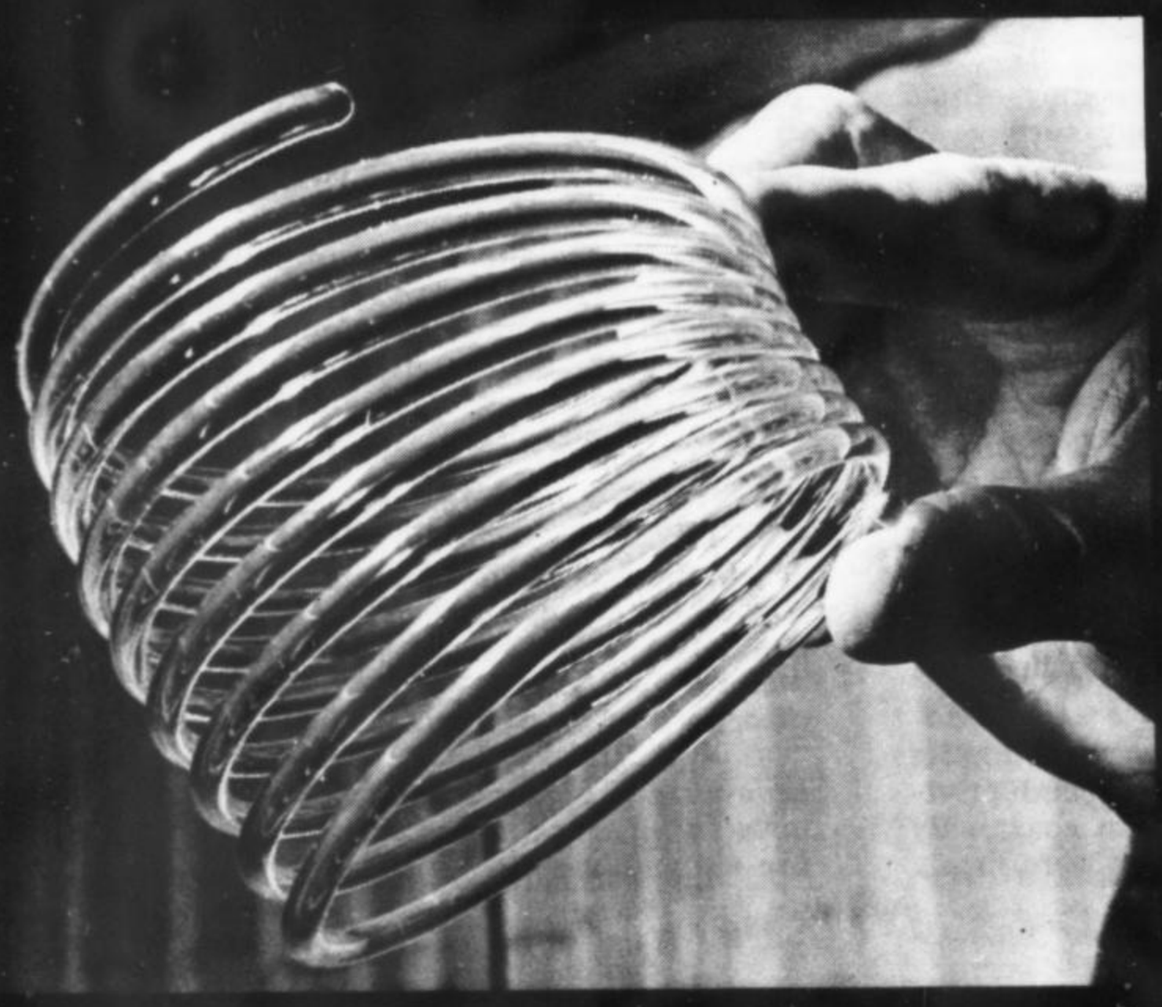

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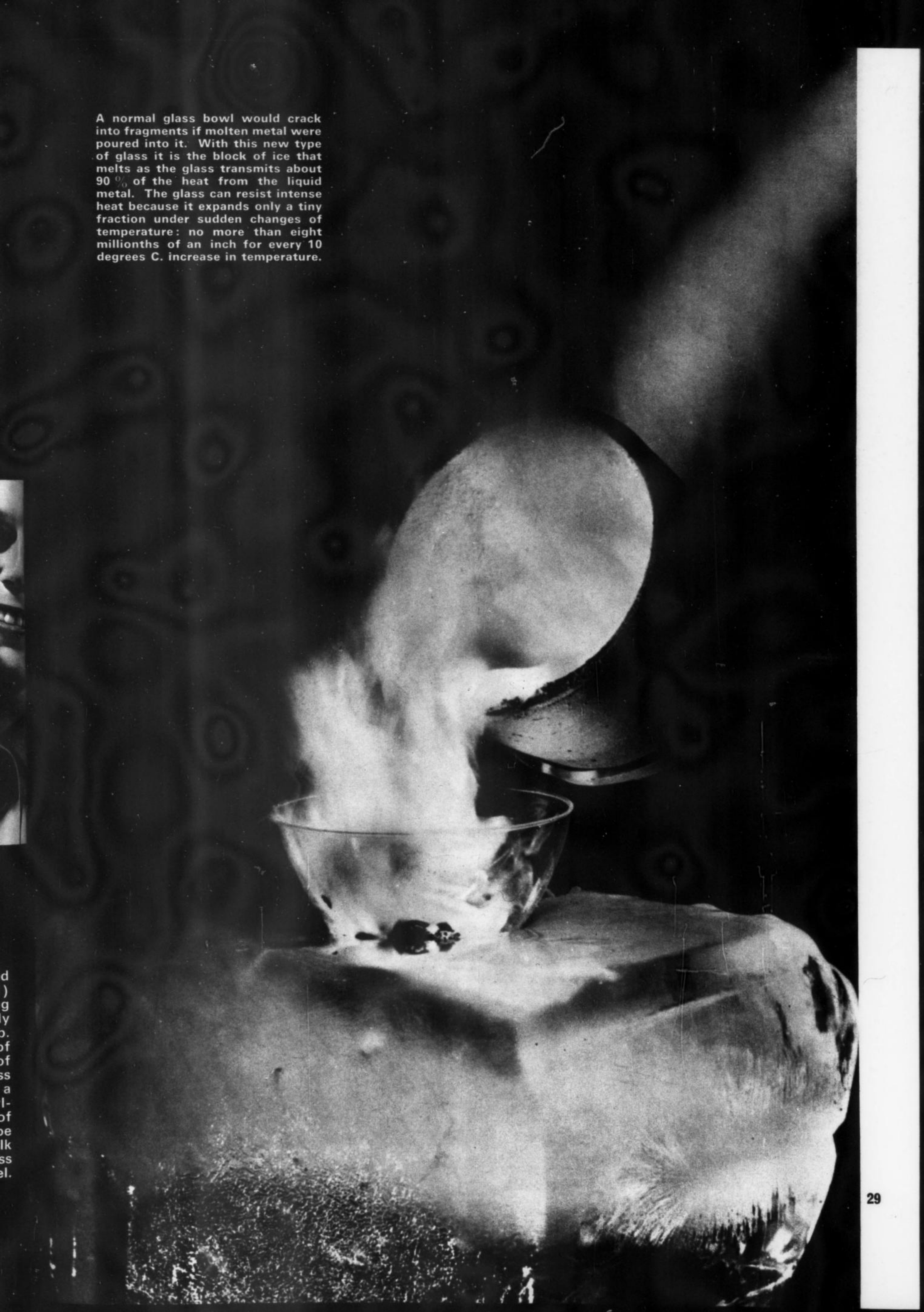
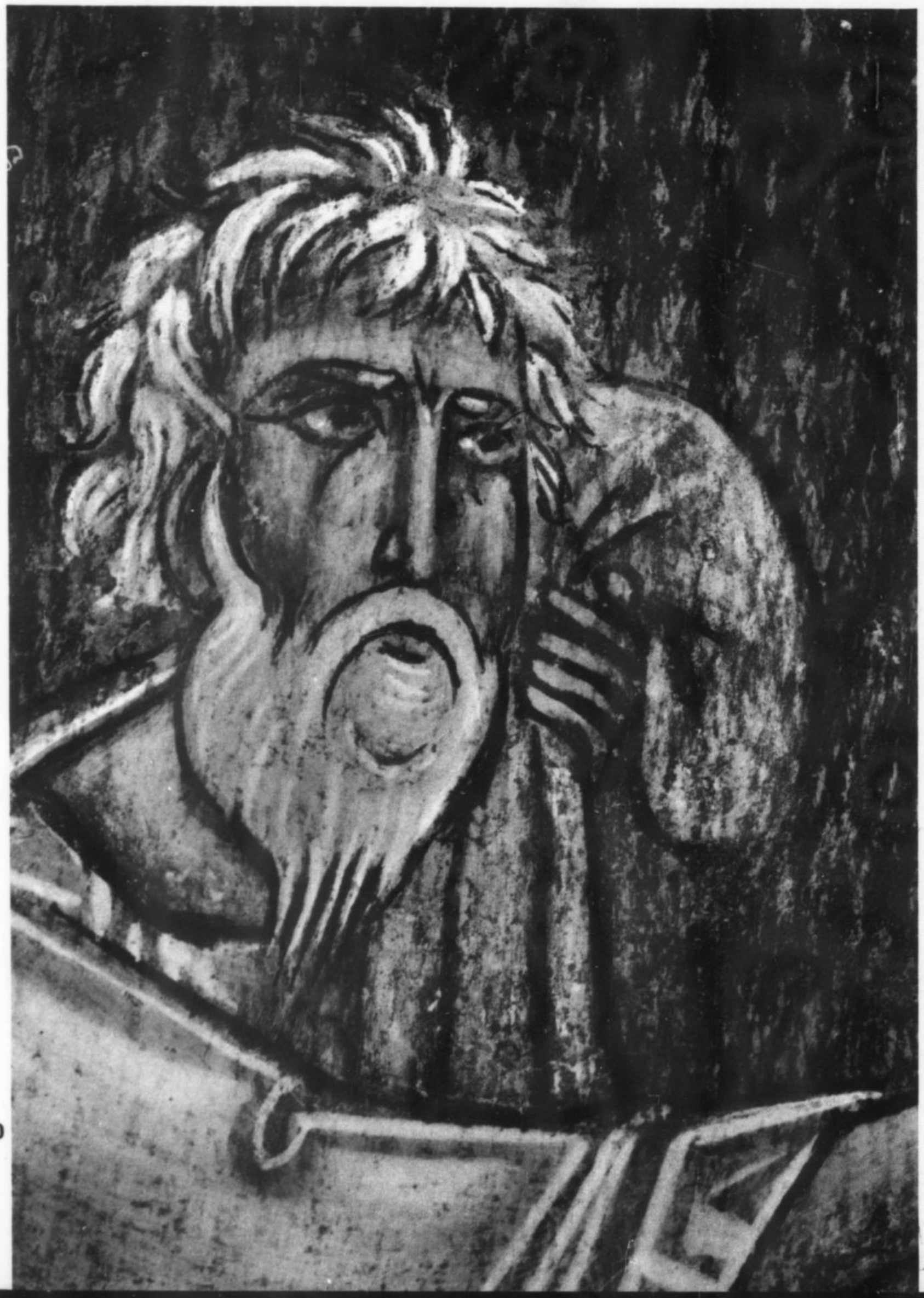
Here are some other unexpected properties of modern glass: (1) Though traditionally an insulating material, this sheet of glass actually transmits current to the bulb. No wires are needed. A film of metallic oxide 20 millionths of an inch thick is bonded to the glass and conducts current as easily as a copper wire. (2) Looped and curled, glass has all the qualities of a satin ribbon. (3) Glass can be "spun" into a fibre as soft as silk and as fluffy as wool. (4) A glass coil as hard and springy as steel.

Photos © Three Lions, New York

A normal glass bowl would crack into fragments if molten metal were poured into it. With this new type of glass it is the block of ice that melts as the glass transmits about 90 % of the heat from the liquid metal. The glass can resist intense heat because it expands only a tiny fraction under sudden changes of temperature: no more than eight millionths of an inch for every 10 degrees C. increase in temperature.





Group of mourning Apostles (top of page) is a detail from a fresco, "The Dormition of the Virgin", painted by an unknown 12th-century artist in the little church of Asinou, Cyprus. Left, St Andrew, a detail from the same group.

© Unesco

"The Donors", from the church of St. Mamas at Louveras, dates from 1465, at which time there was an extensive revival in Cyprus of painting in the Byzantine tradition, though with a local character.

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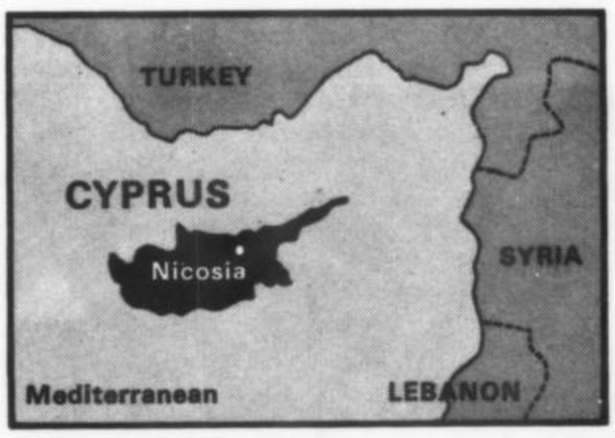
A new Unesco art album

CYPRUS Byzantine frescoes and mosaics



The island of Cyprus has been an independent republic since August 16, 1960. One hundred and forty miles long by sixty miles wide, it has nearly 600,000 inhabitants, of whom 100,000 live in Nicosia, the capital. The majority of its population comprises two main groups: people of Greek and Turkish descent. Although chiefty agricultural, Cyprus has important mining deposits, particularly of gypsum and copper. Situated at a Mediterranean cross-roads used by many great civilizations of antiquity, Cyprus became a melting pot in which artistic traditions from Mesopotamia, Phœnicia, Greece and Rome flowed and mingled. Cyprus is the only United Nations member state whose own outline—an island silhouette in gold—appears as an emblem on its flag.

It was not until 1931 that a systematic survey of paintings and mosaics in Cyprus revealed the full extent of the island's artistic heritage. Carried out under the direction of the Byzantine Museum in Athens, it paved the way for a restoration and preservation campaign that is still in progress.

The mosaics and frescoes in the churches of Cyprus are not merely works of great beauty; they are the record of an artistic development closely linked with historical events on the island.

Down the centuries Cyprus has known many rulers and been subjected to many influences. On the division of the Roman Empire it became a Byzantine province. From the 7th century onwards it experienced Arab invasions, and Byzantine authority was not restored until 965 A.D. From the 13th to the early 16th century the island was ruled first by the French dynasty of the Lusignans and, from 1489, by the Republic of Venice. It fell to the Ottoman Empire in 1571. Social upheavals and new cultural patterns all left some imprint on the art of Cyprus, but never managed to efface its original Byzantine characteristics.

The island was slow to recover from the effects of the Arab invasions. Mosaic decoration, in fact, never revived, but the art of fresco painting came to life once more and developed vigorously throughout mediæval times. One of the island's mediæval monuments is the Hermitage of St Neophytus. Here, near Paphos, this cave-dwelling Cypriot recluse lived for half a century from 1159 A.D.

CONT'D ON NEXT PAGE

Citizens of Jerusalem (left) greet Jesus as he rides into the city, detail of one of a series of 13th-century paintings in the Church of St.Heracleidius at Kalopanagiotis, Cyprus. Below, the Archangel Michael, detail of a 12th century work, "The Anastasis", a fresco painted in the monastery of St. Neophytus, near Paphos, Cyprus.

© Unesco

Little-known masterpieces of art

Among the frescoes on the walls of his cell is one signed by Theodore Apseudes, one of the earliest Byzantine painters known by name.

As long as Cyprus, under Lusignan rule, remained linked to the Latin Kingdom of Jerusalem, the Cypriot painters were subjected to the influence of their Latin overlords. Later, with the Venetian regime, orthodox church decoration increasingly absorbed Renaissance elements. But the Cypriot fresco painters always preserved much of the Byzantine style of which, in its purest form, Cyprus possesses such fine examples.

A new album in the Unesco World Art Series, "Cyprus: Byzantine Mosaics and Frescoes" has been devoted to these still little-known masterpieces of art; 32 full-page colour reproductions present works executed between the 6th and the 15th centuries. This album, the 20th in the Series, is published by the New York Graphic Society by arrangement with UNESCO. Printed in Italy by Amilcare Pizzi, Milan, the album is priced at $18.00 or equivalent.

Letters to the Editor

STANLEY MONUMENT

Sir,

On the back cover of your November 1963 issue you published a photo of one of the three statues composing the monument to Henry M. Stanley at Leopoldville. As the sculptor of these three statues I was delighted to see this photograph but, as I am sure you will appreciate, I would have liked some mention to have been made of their author in the caption.

Ianchelevici
Maisons-Laffitte, France

EAST-WEST CONTACTS

Sir,

Congratulations on the excellent articles, "Orient-Occident: A Study in Ignorance" (April 1963 issue).

I always find THE UNESCO COURIER interesting and instructive. Your publication is certainly playing a vital role by giving its readers a wealth of enlightening information. East-West understanding is very important for world peace. In this regard, I believe correspondence helps us a great deal. I suggest people in the West write more to those in the East and vice versa.

Yoshitatsu Kimura
Shinjuku-ku, Tokyo, Japan

THE MITTENWALD TRADITION

Sir,

The article by Claude Marly, "Music on a String" (Sept. 1962) provided a glimpse of the nature and history of stringed-instrument making, but omitted a number of facts which should be stated. For example, the wood for the resonant box (*Picea excelsa*) is found not only in Switzerland, but all over the Upper Alps, the most prized being the spruce fir of Upper Bavaria. This was an important factor in the development of instrument-making at Mittenwald.

Much has been written about violin varnish and in particular about its so-called secret composition which has no doubt greatly impressed authors and readers alike. However, I would say that it is not the nature of the composition of the ancient Italian varnish that has been lost, but understanding and knowledge concerning the organic, natural varnish and its ageing. This has been lost little by little as the craft became more commercialized, to the detriment of the creative spirit of instrument-making.

Your article also omitted to mention stringed instrument-making in Germany, its impact in 14th-century Europe and its most flourishing period in the 15th century. From Füssen it spread far and wide and led to instrument-making in Mittenwald—"The Cremona of Bavaria" as it has often been called.

In the time of the great Jacobus Steiner and the master instrument makers of the Klotz family, the achievements of Mittenwald represented, both in Germany and neighbouring countries, the acme of instrument-making. The sonority of Mittenwald's violins corresponded exactly to the tastes and ideals of that period. In a historical context, German stringed instrument-making is thus placed between the Italian and the French. There was no reference to Mittenwald in your article, which, to give the complete picture, should also have mentioned Markneukirchen in Saxony, the Czech production centres, and the new German centre of Bubenreuth. Austria, the Netherlands and Switzerland have had individual master-craftsmen, but no recognized centres of stringed instrument production.

Today, Mittenwald is no longer a great production centre but its school of instrument-making, which has existed for over a century, maintains the tradition and draws young student craftsmen from all parts of the world. The teaching is based on international experience and knowledge in instrument-making, and is constantly adapted and modernized. The school aims to restore to instrument-making the brilliance and perfection conceived by the great masters of the past.

Completed instruments hung to dry at the Mittenwald School.

K. Leonhardt,
Director, Mittenwald School of Stringed Instrument-Making,
Bavaria, German Federal Republic

HOW MANY ESPERANTISTS ?

Sir,

In "One Language for the World" (Nov. 1963 issue) Professor Mario Pei says that something like eight million people speak Esperanto. This is far more than the most optimistic estimates. In a report submitted to UNESCO in 1951, the Universala Esperanto Asocio quoted the already greatly exaggerated figure of 380,000 Esperantists. Allowing for the fact that this association, which includes every kind of Esperantist, from the most skilled exponents to the merely interested, had 32,660 members on January 31, 1962, it seems likely that the world total of people who actually speak Dr. Zamenhof's language to a greater or lesser degree can hardly be more than 55,000 or 60,000.

F. L.
Villejuif, France

ED. NOTE: *Professor Mario Pei writes: The estimate of eight million people who, in one fashion or another, speak Esperanto, was supplied to me by the former Secretary of the Esperanto League of North America.*

He stated at the time that this was frankly a very rough estimate, possibly a little on the optimistic side, based on unofficial figures from Esperanto groups all over the world. To my knowledge, there is no precise census of Esperanto speakers. The figure, according to this official, was intended to include not only registered members of official Esperanto groups, but also those not so registered, and those who, at one time or another, had studied Esperanto and taken an interest in the language, even if not in the movement.

On this basis, the figure does not seem exaggerated. In the United States, a nation that is certainly not among those most interested in either Esperanto or the international language problem, I have been amazed in the course of my travels to find Esperanto groups in all the major cities. In countries where the movement is much stronger than it is here (Brazil, Japan, Holland, the Scandinavian countries, to mention a few), it stands to reason that the number of people interested must be much larger. How else to explain the very flourishing Esperanto literature, and the numerous periodicals?

In the case of a constructed language like Esperanto, one cannot speak of "speakers" in the same sense that one speaks of speakers of national languages like English or French. I have devoted considerable attention and study to Esperanto, but I must admit that I do not handle it with anything like the fluency with which I handle the national languages I know best (English, French, Spanish, Italian). At the same time, I feel that my description applies to me. Really fluent speakers, who handle Esperanto with the same facility with which they handle their own native tongues, probably come closer to the figures cited by your correspondent.

At any rate, it must be admitted that the hypothetical figure of eight million is only a rough estimate, and that an actual census of speakers of the language, even on a limited scale, has never been taken.

From the Unesco Newsroom...

PRONGHORNS ON THE INCREASE: Forty years ago the pronghorn, North America's only native antelope, was almost extinct in the state of North Dakota. Only five herds totalling about 225 animals remained. Today, thanks to careful conservation, there are about 10,000 head of antelope in the state.

TUNISIA'S EXPANDING EDUCATION: Last year over 520,000 children were enrolled in Tunisia's elementary schools—an increase of nearly 10% over the enrolment for 1962. A branch for teacher training has been set up in every secondary school to help train the additional teachers needed for Tunisia's expanding educational programme which aims to bring every child of primary school age into the classroom by 1968-69.

FOR AFRICA'S JOURNALISTS: An eight-months' regional training course for journalists in the French-speaking countries of Africa, organized by the government of Senegal and UNESCO is now being held in Dakar. Senegal and UNESCO are also co-operating in the setting up of an institute for the study of the science and techniques of information and journalism in Dakar.

NATIONAL PARK FOR FRANCE: France now has its first national park, La Vanoise, which is in the Savoy Alps and adjacent to the Italian National Park of the Gran Paradiso. In the newly-named French park, which covers 55,000 acres, shooting, except to destroy harmful animals, is forbidden. France's second national park is expected to be the island of Port-Cros off the Mediterranean seaport of Hyères.

INDIA'S SCIENCE CLUBS: Nearly 200 schools in southern India have started science clubs under a scheme sponsored by the All India Council of Secondary Education. The idea for the clubs came from a meeting held in Paris under UNESCO auspices. In Madura, where Indian teachers have also started a club with the aim of improving aids for science teaching, 400 different aids have been designed and distributed to six pilot schools.

SURGERY BY MAGNETISM: Hospital patients of the future may have tiny metal pods creeping about in their bodies under remote control. This development is foreshadowed in research recently announced by the Weizmann Institute of Science, in Israel. The little pods will be propelled and guided by magnetic fields in blood vessels and other tubes and ducts of the body, delivering drugs where they are most needed and even performing operations. In experiments on dogs, a pod has been manœuvred through the heart very easily.

DIALING THE WORLD: Telephone experts of the International Telecommunications Union opened the way recently to a world-wide direct dialing system. Meeting in Rome, they agreed on dialing codes to cover the next 40 years, which will accomodate a global telephone system with 600 million subscribers (compared to 141 million in 1961). A substantial step will come this year when much of Europe will be linked up by a direct dialing system.

'TELLING THE U.N. STORY': A comprehensive yet compact handbook for all who wish teach or learn about the United Nations has just been published by UNESCO under the title "Telling the U.N. Story" (In Eng. and Fr. editions, price 6/-stg.; $2.00: 4,50 Frs). Its author, Leonard S. Kenworthy, Professor of Education at Brooklyn College, City University of New York, reviews teaching about the U.N. and its related agencies, discusses the aims and themes of this teaching and ways to improve it. He also offers suggestions on setting up a comprehensive teaching programme.

TELEPHONE FOR THE DEAF AND MUTE. Scientists at the Israel Institute of Technology in Haifa have been experimenting with a "telephone" which would enable deaf-and-mute persons to communicate. The speaker "plays" on sensitive vibration keys as he would on a piano, while the listener places his fingers on a vibration-receiving diaphragm. A duplicate reversed system enables the "speaker" to become the "listener". The language is based on coding the tactile vibrations, on either a single or multiple frequency. A three-frequency code, for instance, makes possible the development of a language of nearly 5,000 words.

INDONESIA'S NEW RESEARCH SHIP: A new 700-ton oceanographic research ship has brought the flag of Indonesia into the fleet of scientific vessels from 14 countries which are now participating in the International Indian Ocean Expedition. Co-ordinator of the expedition is the International Oceanographic Commission.

CELTIC STATUE TROVE: A hundred and forty wooden sculptures dating from the 2nd century A.D. have been discovered by French archæologists working near the source of the Seine not far from Dijon. Excavations revealed about 20 complete statues of human figures, collections of limbs and heads of animals all carved in oak. The finds throw a new light on Celtic art, particularly on wood carving of which few examples exist in museums.

MUSIC MISSION TO ETHIOPIA: George Byrd, an American musician, has recently been on a UNESCO mission in Ethiopia, helping to develop a school of music, building up a national orchestra and, using a new accelerated teaching method, training future teachers of music for Ethiopia's schools.

UNESCO CLUBS LINK HANDS: A UNESCO club formed by children at the Léon Mba Lycée in Libreville, Gabon, has concluded a "twin" partnership with a similar club in Nantes, France, creating the first link of this kind between two UNESCO clubs. The two groups will exchange letters, news bulletins, tape recordings and, like all UNESCO clubs, will make special efforts to promote the aims of UNESCO in their areas. Four other African countries are now forming UNESCO clubs for boys and girls.

Flashes...

■ *Of the one million children who die every year in Latin America, one in every seven is under the age of five, WHO reports. Malnutrition, mainly lack of proteins, and diarrhoeal diseases are the two major causes of death in this age group.*

■ *In Africa, only 16% of the children of primary and secondary school age are enrolled in schools and a hundred million men and women cannot read or write. In Asia, with nearly 400 million children aged between 4 and 15, only 165 million are enrolled in school.*

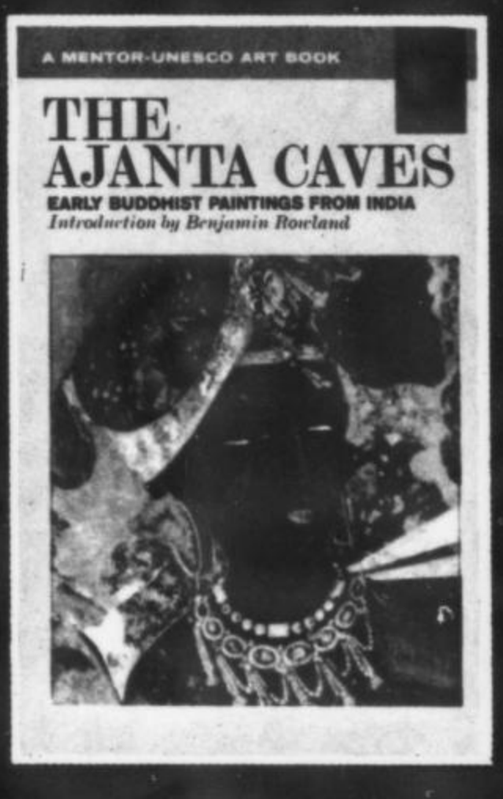
■ *Argentina and Albania have become the 19th and 20th countries to ratify the Convention against Discrimination in Education sponsored by Unesco.*

■ *More than 500,000 pages of valuable manuscripts and books have been microfilmed by the Unesco Mobile Microfilm Unit during a 6-month visit to Morocco. All the material microfilmed is taken from the Moroccan National Library and Archives, in Rabat.*

FOR SAFETY AT SEA

THE Inter-Governmental Maritime Consultative Organization (IMCO) a Specialized Agency of the United Nations, works to further international co-operation with regard to shipping, and with special concern for efficient navigation and safety of life at sea (See The Unesco Courier, May 1963). IMCO has now been honoured by the first U.N. commemorative stamp for 1964. Issued in 5c. and 11c. denominations, it depicts two ships at sea under the protection of the IMCO emblem. As agent in France of the U.N. Postal Administration, Unesco's Philatelic Service stocks all U.N. stamps and first day covers currently on sale, and those issued by Unesco member states to commemorate important events in the history of Unesco and the U.N. For prices and further details, write to the Unesco Philatelic Service, Place de Fontenoy, Paris (7e).

Imp. GEORGES LANG, PARIS. IMPRIMÉ EN FRANCE



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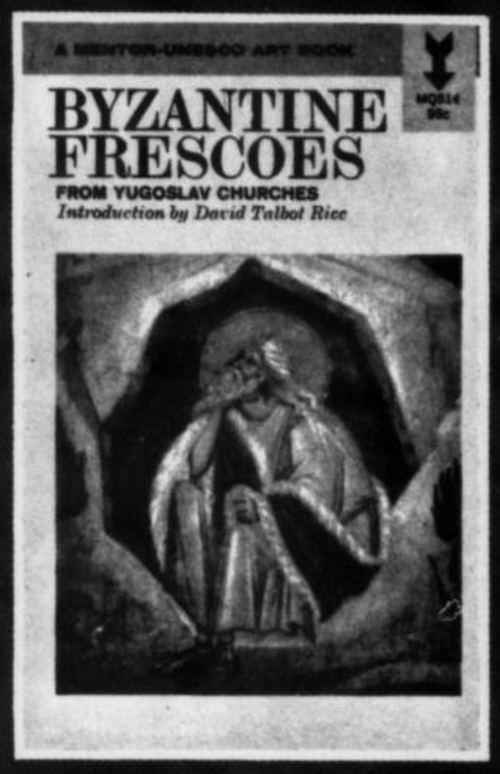

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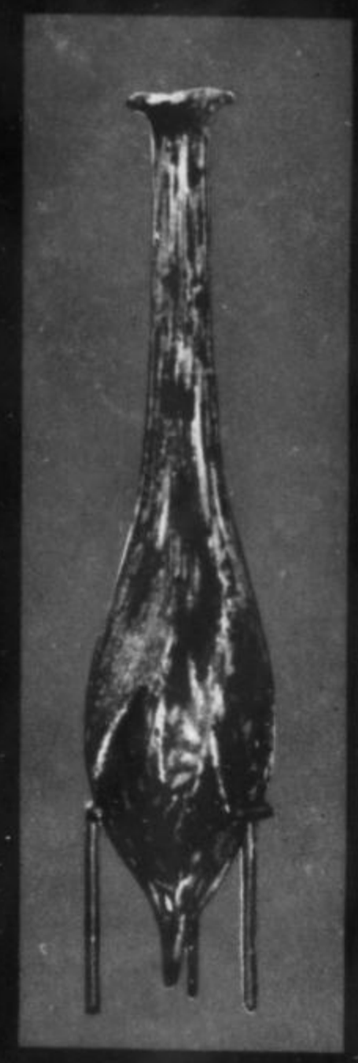
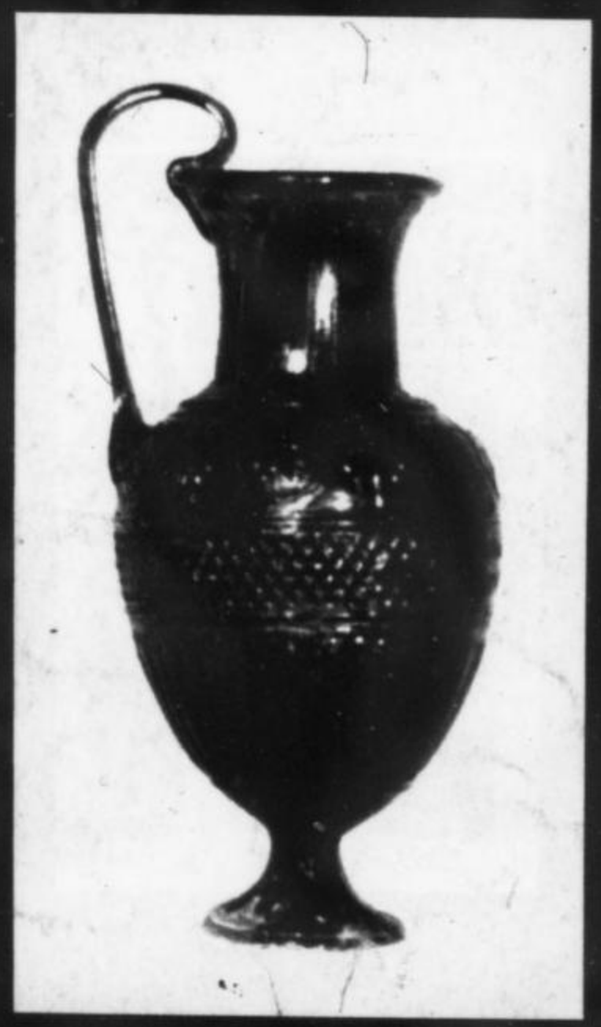
TIMELESS BEAUTY OF GLASS





The first known reference to glass is inscribed on the walls of the temple of Amen-Re at Karnak where the Pharaoh Thutmoses III deposited the treasures he brought from Syria in the 15th century B.C. Archæology has now been able to confirm the long-held belief that glass was manufactured on the Phœnician coast in far-off times. With a beauty rivalling that of precious gems and an infinity of shapes and colours, glass has given delicately artistic forms to even the most everyday objects. Above, a 14th century Mosque lamp from Damascus. Right, a decorated Roman glass vessel. Far right, from top: a marble glass vase; an Islamic period bottle decorated with inscriptions; a blue jug by Ennion, a Phœnician master glass-maker whose works, prized throughout the Roman world, are still sought by modern collectors. See p. 20.

Photos: Haaretz Museum, Tel-Aviv